THE

POPULAR SCIENCE MONTHLY.

AUGUST, 1892.

NATURAL SELECTION AND CRIME.

By Prof. EDWARD S. MORSE.

"Find out what the law of God is with regard to a man; make that your human law, or I say it will be ill with you, and not well! If you love your thief or murderer, if Nature and eternal Fact love him, then do as you are now doing. But if Nature and Fact do *not* love him? If they have set inexorable penalties upon him, and planted natural wrath against him in every god-created human heart—then I advise you, cease, and change your hand."—Carlyle.

THE appearance of General Booth's work, entitled In Darkest England, was followed by a deluge of opinions, articles, and reviews on crime, vagabondage, tenement-houses, slums, etc. The serious spirit of these utterances showed an earnest awakening of the public mind in regard to the ominous character of the submerged classes.* To meet this baleful increase of vagabondage and crime we have had, first, punitive measures, even to mutilation, with no effect whatever, except perhaps as a deterrent to a few of the many thousands implicated; next, indiscriminate charity—public and private—still active in all but a few enlightened cities, with the effect of causing an alarming increase in the number of paupers and tramps; later, organized relief, which, being selective in a measure, results in some good being accomplished; and, finally, the Salvation Army, with rank and file mostly filled from the very classes demanding relief and reform. It would be strange indeed if such an organized force should not leave its impress on the chaotic material of the slums. That a great deal of temporary good, at least, is being accomplished by this organization there can be no doubt.

* Concerning General Booth's scheme, we commend a very just and temperate article in Blackwood's Magazine for January, 1891, entitled The Problem of the Slums.

The subjects of crime and insanity have often been discussed under a common title. In the law courts the plea of insanity is often raised in defense of the criminal. A review of the treatment of maniacs in past times, and criminals at the present time, shows many curious analogies. For these several reasons let us briefly examine the attitude of society toward these unfortunates who are animated in their behavior by the possibly related conditions—insanity and crime.

Insanity was formerly looked upon as evidence of demoniacal possession. The idea that a disordered intellect could be the result of physical disease—of lesions of the brain—was only established after centuries of observation. In the mean while, every torment that misguided man could inflict was frantically suffered by untold thousands of chained and caged victims. Now, thanks to science, a thin section of diseased brain may, by means of the lantern, be projected upon a screen, so that audiences of thousands can realize for themselves the pathological nature of certain forms of insanity.

Dr. Andrew D. White, in his chapter on Demoniacal Possession and Insanity,* says: "If ordinary diseases were likely to be attributed to diabolical agency, how much more diseases of the brain, and especially the more obscure of these! These, indeed, seemed to the vast majority of mankind possible only on the theory of satanic intervention."

It would be difficult to find a more ghastly page of history than is embodied in the two chapters on insanity by Dr. White in his New Chapters in the Warfare of Science. One becomes transfixed with horror at the merciless and ignorant brutality exercised in the treatment of the insane. Patients who required the tenderest care and long-continued sleep were forcibly kept awake for days to drive out the devil that was believed to possess them. Science, long thwarted by the Church, finally wrought a marvelous change in the treatment of these unfortunate creatures, by substituting gentleness, airy rooms, and sunny fields for dungeons, exorcisms, prayers, and blood-curdling cruelties. To one at all familiar with the external aspects of insanity, in its various forms, it seems incredible that its physical nature was not sooner realized.

The writer has had some slight knowledge of insane asylums, not only in America but in Japan, China, and Java, and in all these places, with their different nationalities and consequent facial peculiarities, one could easily recognize melancholia, dementia, and certain other forms of mental disease. The asylum at Buitenzorg, in Java, was of special interest, for here one

* Popular Science Monthly, vol. xxxiv, p. 434.

might see in the different wards Sundanese, Javanese, Chinese, Hindoos, various Europeans, and peoples from other countries, with widely varying features, yet the "cachet," so to speak, of the mental disease could in many cases be recognized at a glance. Had the laws of heredity, even, been earlier understood it would have been seen that mental derangements, like physical diseases and tendencies, were transmitted.

If insanity was formerly considered the evidence of satanic possession, how much more reason was there to believe that delinquencies of a criminal nature were the result of satanic instigation. While demoniacal possession, as an explanation of insanity, is discredited on all hands,* criminal acts are still looked upon as the instigation of the devil. It may be safely asserted that to-day the vast majority of mankind fully believe that an external influence for evil is at war in the individual with an external influence for good.

Atrocious crimes are especially referred to as the result of diabolical suggestion; and the same procedures, though in a milder form, which obtained in former times for the treatment of the insane are in full force to-day in the treatment of the criminal. In the one case, however, torture was used to drive the devil out, in the other the victim is punished for yielding to the devil's persuasion. The criminal is imprisoned, chained, immured in a dark cell, forced to severest labor, and in many prisons abroad subject to physical torture. Under some governments he is transported to torrid climates and compelled to work under a broiling sun, or, hidden from the sun altogether, to delve in mines. This much for the punishment. Similar methods are resorted to in attempting reform, as were formerly used in exorcising the devil from the maniac. The minister and priest, having at all times free access, exhort and pray for the criminal, that he may have strength to resist the evil spirit, and if some sudden revulsion of feelings animates him to struggle against his criminal impulses, as many an insane man succeeds in controlling his maniacal impulses, then it is believed that a new spirit has shed its beneficent influence upon him, or, in other words, the evil spirit has been exorcised. Those who strenuously protest against such an interpretation of sin and crime are branded with obnoxious names. Dr. White says that perhaps nothing did so much to fasten the term "atheist" upon the medical profession as the suspicion that it did not fully acknowledge diabolic interference in mental disease.

---

* This holds good for the present time, but a firm belief in the existence of demoniacal possession in past times is still held by the Church, as lately witnessed in the discussions between Huxley and Gladstone, Dr. Wace, and others, regarding the Gadarene pigs.

A further analogy may be seen between the treatment of the lunatic in past times and the treatment of the criminal in recent years. It will be admitted without question that the former treatment of the insane could only result in driving the victim to utter madness. In an interesting work, entitled Old Bailey Experience (1833), the writer, who shows himself far in advance of his time, in reflecting on the treatment of criminals in England, says, "So convinced am I that the manner in which the laws are administered, under the discretion of the judges at the Old Bailey, has been one of the chief causes of the increase of crime, that it is a perpetual source of concern to me, that the subject has not been taken up by some one more able than myself to awaken the attention of the public." And he proves his position by an overwhelming mass of evidence.

Of late years there has sprung into existence a school of criminal anthropology, with societies, journals, and a rapidly increasing literature. A most admirable summary of the work thus far accomplished has recently been given by Dr. Robert Fletcher, in his address as retiring President of the Anthropological Society of Washington. In his opening paragraphs Dr. Fletcher graphically portrays the scourge of the criminal and his rapid increase. "In the cities, towns, and villages of the civilized world, every year, thousands of unoffending men and women are slaughtered; millions of money, the product of honest toil and careful saving, are carried away by the conqueror, and incendiary fires light his pathway of destruction. Who is this devastator, this modern 'scourge of God,' whose deeds are not recorded in history?—The criminal! Statistics unusually trustworthy show that if the carnage yearly produced by him could be brought together at one time and place it would excel the horrors of many a well-contested field of battle. In nine great countries of the world, including our own favored land, in one year, 10,380 cases of homicide were recorded; and in the six years, extending from 1884 to 1889, in the United States alone, 14,770 murders came under cognizance of the law.

"And what has society done to protect itself against this aggressor? True, there are criminal codes, courts of law, and that surprising survival of the unfittest, trial by jury. Vast edifices have been built as prisons and reformatories, and philanthropic persons have formed societies for the instruction of the criminal and to care for him when his prison gates are opened. But, in spite of it all, the criminal becomes more numerous. He breeds criminals; the taint is in the blood, and there is no royal touch which can expel it."

Certain results of the modern school of anthropology, as presented by Dr. Fletcher, may be briefly summed up by stating

broadly that in studying the criminal classes from the standpoint of anatomy, physiology, external appearance, even to the minuter shades of difference in the form of the skull and facial proportions, the criminal is a marked man. His abnormities are characteristic, and are to be diagnosticated in only one way. That these propositions are being rapidly established there can be no doubt. As an emphatic evidence of their truth, the criminal is able to transmit his criminal propensities even beyond the number of generations allotted to inheritance by Scripture.

William Douglas Morrison, in his Crime and its Causes, while denying these propositions, admits that degeneracy and disease are transmitted, and in these conditions seeks for the origin of crime.

A very significant relation is shown between crime and insanity in figures given by Malcolm Morris, as quoted by Dr. Emily White, in her address on Hygiene as a Basis of Morals.* She says: "The intimate relationship between nervous diseases and crime is conspicuous. In England, the ratio of insane to sane criminals is thirty-four times as great as of the insane to the whole population, and criminal lunatics are in excess in the high proportion of seventeen to one." The persistence of criminal and vagabond taints is even more pronounced than that of lunacy; the latter condition often yields to benign treatment, and there is reason to believe that in time it may be eradicated, though confinement and consequent prevention of offspring will be the main cause of its disappearance. Whether criminal propensities can be obliterated is a grave question. Certainly the irrational and unscientific methods in the treatment of criminals to-day are as much responsible for the increase of crime as were the superstitious and unscientific ways of dealing with contagious diseases in earlier times responsible for their wide dissemination.

The repeated association of certain abnormities of the body with the criminal character suggesting simian features has led to the idea that congenital criminals are instances of reversion. Eminent students in this branch of study call attention to the resemblances of many minor details of structure to features in the higher apes. Dr. Fletcher admits that, while this view may be correct, it is purely hypothetical. The presence of certain abnormal muscles in man have been justly looked upon as evidence of reversion, and certainly the atavistic view clears up many points of structural difference seen in the criminal class which would otherwise be obscure. It is possible, however, that if the antecedents of all criminals were known, retention of ancestral traits and not reversion would be the more probable explanation

* Popular Science Monthly, May, 1887.

of the continuance of the congenital criminal. He has always existed; his presence is apprehended just in proportion to the sensitiveness of the public conscience. Morrison, in his instructive book, says, in regard to the confirmed vagabond and criminal, that "most of them are not adapted to the conditions of existence which prevail in a free society. Some of them might have passed through life fairly well in a more primitive stage of social development, as, for example, in the days of slavery or serfdom; but they are manifestly out of place in an age of unrestricted freedom, when a man may work or remain idle just as he chooses. . . . All men are not fitted for freedom, and, so long as society acts on the supposition that they are, it will never get rid of the incorrigible criminal."

The persistence of those acts which, as society has evolved, have been deemed criminal, are acts natural to all animals. In the decalogue half the commandments, significantly grouped together, refer to acts and impulses inherent in the animal kingdom, from the lowest to the highest. Murder and adultery, of course; covetousness precedes the act of stealing; theft, in its various forms, from the simplest act to stock-watering; and lying, from the deceptive behavior of a bird to the lies embodied in the advertisements of the modern newspaper—are all part and parcel of man's inheritance.

Dr. Bruch Thomson, Surgeon of the General Prison, Scotland, says, "Habitual criminals are without moral sense—are true moral imbeciles." Carl Vogt advanced the idea that certain cases of congenital idiocy were evidences of reversion. Let one spend a few hours only in the worst wards of an asylum for the feeble-minded, and attentively study the movements and desires, the wanton mischief, the shocking impulses which animate these unfortunate creatures, and he is forced to admit the possibility of such a condition.

Whatever view prevails does not concern us at present. The important truth to realize is that overwhelming and incontestable evidence shows that the criminal, as a type, not only exists, but that his criminal taints are transmitted, and that this transmission may run through many generations. It is proved by voluminous evidence, easily accessible, that children are born criminals. They are, as Dr. Fletcher says, not only reared, nurtured, and instructed in it, but the habit becomes a new force—a second nature—superinduced upon their original natural depravity. In speaking of this class he says, "These communities of crime, we know, have no respect for the laws of marriage, are regardless of the rules of consanguinity, and, connecting themselves only with those of their own nature and habits, they must beget a depraved and criminal class, hereditarily disposed to crime."

It should be understood that in speaking of criminals the modern classification of criminals is recognized, and only the instinctive or congenital criminals are here considered. In this presentation, however, we must include the vast army of tramps who move with the snow-line back and forth across the country; a horde continually increasing because, as with the criminal, the vagabond strain is continually being bred. This startling truth of inheritance must be emphasized again and again, till the public mind—slow to understand—shall finally realize the fact and take the same stern measures for suppression that it would in the case of polluted water-supply and contagious disease. When these matters were fully understood health boards came into existence, and with such arbitrary powers are they now endowed that a family can be imprisoned in its own house; the house may be destroyed; the dead, if necessary, denied the ordinary funeral observances. The public fully acquiesce in these heroic measures, for the death-rate figures, year after year, become too significant to be neglected.

Vagabonds, like criminals, spring largely from a degenerating stock. The persistence of the vagabond strain, the hopelessness of reform among those blasted with the taint, is strikingly portrayed by the lamented Rev. Oscar C. McCulloch, in an address read before the National Conference of Charities and Corrections (1888), entitled The Tribe of Ishmael, a Study in Social Degradation. Traces of this tribe have been found as far back as 1790, but from 1840 the record is quite made out for some twigs of this baleful stock. Mr. McCulloch says: "The individuals already traced are over five thousand, interwoven by descent and marriage. They underrun society like devil-grass. Pick up one, and the whole five thousand would be drawn up. Over seven thousand pages of history are now on file in the Charity Organization Society" (Indianapolis), and he asks: "Do any of these get out of the festering mass? Of this whole number, I know of but one who has escaped, and is to-day an honorable man. I have tried again and again to lift them, but they sink back. They are a decaying stock; they can not longer live self-dependent. The children reappear with the old basket. The girl begins the life of prostitution, and is soon seen with her own illegitimate child."

The tramp horde is a nidus from which apparently a vast number of criminals spring. The appalling character of the fruits of this nidus may be faintly realized by reference to Dr. Seaman's paper on the Social Waste of a Great City (Science, vol. viii, p. 283). Referring to New York, he says: "It seizes upon and subsidizes the fairest string of islands that grace a metropolis the world over. Where there might have been, under a shrewder, better providence, parks, groves, museums, art-gal-

leries, zoölogical gardens, wholesome games, exhilarants for honest industry and useful thrift, stretching at little intervals from Governor's to Hart's Island, full eighteen miles, the Nemesis of penalty and retribution has planted her growing colonies of social waste, of broken, degraded, repulsive, dangerous human detritus: and this baleful colonization has pushed its way along those beautiful eastern waters, keeping step with the advancing city, until its entire line of eastern frontage, far up into Westchester County, is sentineled by these menacing excrescences of a moribund civilization." Dr. Seaman truly says: "This waste shows a deadly apathy, a dying out of purpose, a fatal estrangement from home, family, and society, for which there has, as yet, been found neither remedy nor cure. This tramp class grows and grows dangerous and desperate too, and is chargeable with an increasing number of outrages, assaults, and crimes against both property and person. The island, the almshouses, and workhouses do not reach or touch their cases, for they gather physical endurance and resources from fresh campaignings across country, until rounded up again by winter weather in the great cities."

Indeed, the daily accounts of innocent women murdered, railroad trains invaded, pitched battles between hordes of these vagabonds and law-abiding citizens, attest to the insidious and rapid spread of this class, and not until some town is burned, and plunder and rape follow the burning, will the people realize what they have for so many years deliberately encouraged by free lunches at their kitchen doors. Indiscriminate charity has been encouraged by religious teaching. Powerful as the Church has been and still is in support of this practice, it is astonishing how rapidly the evils of this pernicious custom are being recognized by charity boards. Mr. McCulloch says the "so-called charitable people who give to begging children and women with baskets, have a vast sin to answer for. It is from them that this pauper element gets its consent to exist. Charity—falsely so called—covers a multitude of sins, and sends the pauper out with the benediction, 'Be fruitful and multiply.' Such charity has made this element, has brought children to the birth, and insured them a life of misery, cold, hunger, and sickness." And he asserts that so-called charity joins public relief in raising prostitutes and educating criminals. Though these are strong words, they but repeat the testimony of others who have made the subject an attentive study. In an article on London Charities, by Elizabeth Bisland (Cosmopolitan, July, 1891), is quoted the words of an eminent London citizen, who says that London is the scandal of the age by reason of its pauperized and demoralized condition, and yet $25,000,000 is given each year in alms to the unfortunate. "It is a gigantic laboratory of corruption and crime, and while it as-

pires to Christianize the heathen, it exercises a far more direct and effectual influence in heathenizing Christians, and in dragging the rest of England down to its own low level." And he goes on to declare that "the enormous facts of London charity are to a lamentable extent responsible for this state of things."

Whether the law-abiding man is abnormal, according to Albrecht, and the criminal is normal—slaying and robbing without compassion, as do the animals below him—does not now concern us, for it has come to pass in the progress of the races that the moral man has formulated laws for the good of society, and insists upon obedience to their establishment. Intelligence and not brute force has become the main factor in man's selection. This has been foreshadowed in past geological times where it has been shown that in the progressive development of the various groups of mammals the brain increased in size out of all proportion to the size of the body. An ignorant man in civilized countries, and even in savage and barbarous countries, occupies the lowest position.

Among the dominant races ignorance, poverty, and crime are often associated. The association of poverty and crime has no immediate relation, as shown by Morrison, though poverty presupposes a low intellect, and this implies an inability to acquire an education, which in a hundred ways in civilized life leads to degeneracy and crime. It can probably be shown that nations that are in the worst plight politically and financially are those where general education is or has been at the lowest ebb, where superstition takes the place of knowledge. In Italy, for example, where an attempt to disinfect cholera districts results in the murder of the officers engaged in this beneficent work—where priestly processions and holy water take the place of quarantine and carbolic acid in fighting cholera—natural selection runs riot and mercifully removes priest and peasant alike. One word in that famous encyclical, in which half its anathemas were hurled against human reason and the sciences,* might have changed all this, but the Church's attitude on these questions is one of the great factors in the selective category.

In this operation of the law of natural selection we have plainly indicated to us the principle with which to fight crime and pauperism. Let us pause for a moment and observe a few of the many ways in which this selective action is working in regard to man, and the suggestions to be derived from it. That the principle of natural selection works in Nature, no intelligent man doubts to-day. The discussion between Prof. Weismann and his adher-

* See Draper's Conflict between Religion and Science, for convenient reference to these anathemas, p. 350.

ents and the Neo-Lamarckians, as to whether acquired traits are transmitted, only tends to bring out more vividly the simplicity of the law of selective action. Man, as regards himself, has apparently thwarted this law. The humane impulses of man often interfere with selective action; sentimental women and sympathetic magistrates assist in the freeing of criminals who usually find themselves "serving" time by an immediate repetition of their offenses, often in aggravated forms (*vide* Sawtell), having, however, while free, united, out of wedlock, with the lowest of their kind, to perpetuate and possibly accentuate their criminal taint.

The indiscriminate giving of alms and promiscuous feeding of tramps thwarts, in a measure, the work of selective action. Were it not for these interferences the diminution in number of the vicious, incompetent, and lazy would be as marked from year to year as is the decreasing death-rate in cities where sanitary measures are rigorously enforced. What, then, are the unfavorable conditions against which the uneducated vicious class have to contend? In nearly all the essays written on crime and its causes, authors finally unite in agreeing that the slums of a city are the main roots of the evil, or, more correctly, the culture element which fosters this mass of social corruption. Mr. B. O. Flower, in the Arena, says, "The slums of our cities are the reservoirs of physical and moral death, an enormous expense to the state, a constant menace to society, a reality whose shadow is at once colossal and portentous."

As a class, these people live under the worst sanitary conditions, in districts of the city having the highest death-rate. Miss Besant, in a lecture, says: "In London the population is between three and four millions, and of it one person in every five dies in jail, prison, or workhouse. Fifty-five years is the average of citizens of the comfortable class, while twenty-nine is that of the manual laborers. . . . Of one hundred babies born, fifty lie in the cemetery before they are five years old, while of the upper classes but eighteen of every hundred die." (In one city in Europe, where a long series of observations has been made, it is found that the death-rate is higher on the shady side of the street.)* The hot blasts of summer and the chills of winter mark their quota; their ignorance of all medical science leads them to employ a quack, or languish and die without medical aid. If inclined to work, their unrestrained appetite for alcohol shuts them out from all positions of trust, and drives them to the roughest of manual labor often fraught with danger. Their carousals and fights, innutritious and unwholesome foods, violations of all sanitary laws, and many

* Some of the following paragraphs have already been published by the writer in the Boston Herald, under the signature of C. B. D.

other agencies are at work in destroying those least capable of surviving. As among the animals below man, where many individuals best adapted to live perish with the thousands unfitted to survive, so with man does this ruthless but beneficent law take in its grasp many deserving ones, and these are the ones that all the impulses of charity and love should animate us to save.

In combating crime, then, the line of effort should be along those paths indicated by Nature. It is a curious commentary on man's intelligence that, while exercising the selective function on his domestic stock by careful feeding, proper housing, and judicious crossing, and for his plants selecting the best seed, etc., while ruthlessly destroying the noxious weeds, yet when he comes to his own kind he fancies that different laws operate with him, or, swayed by sentiment, looks for different methods to cope with crime. He exterminates the noxious weed, kills his vicious dog, puts under restraint the maniac until cured; no definite terms of banishment will do in these cases, yet he formulates laws in which there is apportioned a definite number of days or years for definite offenses against society!

Colossal organizations, with lavish appropriations, are in the field for the purpose of suppressing crime and pauperism. Until within a few years this great army has been officered by the Church, and plans of campaign have been mapped by it. Slowly the public intelligence is awakening to the fact that these methods have been ridiculously inadequate, as proof exists that crime and pauperism are steadily increasing. The law of indefinite terms of imprisonment for criminals committed for a third offense has been the wisest prison law ever passed, for, by such a law, criminals are the longer prevented from the chance of perpetuating their evil traits; and yet in Massachusetts there are misguided sentimentalists who oppose the enactment of this law.

In this view of the subject the death-penalty—so odious to thousands—may be abolished. The sentence of life-imprisonment may be passed instead, but this must be beyond the interference of any pardoning power. How far the prison-cell may be made attractive, as apartments and corridors in lunatic asylums are made to-day, depends upon the necessity of punitive methods. If punishment, even to flogging, is deemed necessary, criminals must not have offered them such allurements as should lead them to violate the law for the sake of a recommital.

The conditions favorable to crime having been apprehended in the slums of the cities, the law of natural selection having been shown to be as relentlessly at work with man as with the lower animals, it would seem that the line of work is very clearly defined. We are to aid the law of selective action with all our might. Public outdoor relief is in most cities suppressed; indis-

criminate charity has still full sway. We are individually and unitedly to suppress the idle, incompetent, and vicious, and at the same time we are to help in every way the industrious and well-intentioned. The congenital criminal and the vagabond we are to imprison for an indefinite time; in this confinement they should be made to work. Paul said that "if any would not work, neither should he eat." Tasks that do not compete with honest labor should be devised for them—breaking stone, sawing and cutting wood for the deserving poor; in certain districts, working on the road, filling malarious tracts, etc.

These are the suppressive and punitive methods, on the one hand; the selective method, on the other hand, is to be found in the erection of wholesome tenement-houses. These should have amusement halls; gardens, if possible; reading-rooms and libraries; halls, where instructive lectures should be given—not on the Holy Land or Babylonian antiquities, but on bread-making, the chemistry of common life, hygiene, and cognate subjects. Talented men and women will be induced to give their services occasionally to entertain or instruct.

Adopting the deed of trust under which the Peabody buildings in London were given,* we should apply the selective action by letting the apartments at the lowest possible rate to all those who are temperate, industrious, and are willing to work, while the vicious and the evil disposed should be rigorously excluded. "Cruel!" you say; but we should recognize the far-reaching mercifulness of this plan in preventing the bringing of vicious children into the world, to live a life of misery and shame, or, if brought in, to find such unfavorable conditions as shall remove them while still young.

Quarantine the evil classes as you would the plague, and plant on good ground the deserving poor. Those who talk about the liberty of the individual before the law are not to include those who are endangering the liberty, perhaps the lives, of others, and are transgressing the law at every step.

Having established the means by which selective action may be brought into play, and in so just a manner, too, that even a vagabond could not complain of its injustice, we are to establish conditions by which the offspring of such colonies may have every chance of continuing in the life of sobriety and industry

* Secondly. It is my intention that now, and for all time, there shall be a rigid exclusion from the management of this fund of any influences calculated to impart to it a character either sectarian, as regards religion, or exclusive in relation to party politics.

Thirdly. It is my wish that the sole qualification for a participation in the benefits of the fund shall be an ascertained and continued condition of life such as brings the individual within the description (in the ordinary sense of the word) of the poor of London, combined with moral character and good conduct as a member of society.

under which they were brought into the world. For this purpose industrial schools, in all lines of work, should be established. The crying need in all trades to-day is for boys who will industrially continue their apprentice term. During this time the boy must be induced to live at home, caring to live there from the attractiveness of the surroundings. Music, lectures, thanksgiving dinners, flowers, etc.—the outflow of compassionate impulses, which make certain penal institutions so alluring to many criminals—will find a better destiny in making pleasanter the lives of deserving tenement dwellers. Cooking schools, training schools for nurses and servants, should be instituted for the girls. With such co-operating appliances, our charity committees, instead of the often despairing tramps through noisome regions, to be deceived by the wary, or horrified at the treachery and lies of others, will have a keen stimulus to seek out the deserving poor; to find those that are willing to work, knowing that, when once rescued and placed on firm ground, they are to remain there —in many cases self-supporting. The response to appeals for aid will be more prompt and bountiful when it is known that worthy ones only are to be helped. The cost of such a project will be great. If private munificence will not do it, cities may.

In Boston, museums of art and of natural history, though free to the public, are, nevertheless, sustained by private help. In New York the State and city are repeatedly called upon for contributions to similar institutions. What municipality of any intelligence has hestitated to spend millions for pure water-supply and sewer system, after it has been clearly demonstrated that local cesspools menace the health of the community by vitiating the local water-supply? It is possible that, when a community fully realizes the moral pollution that comes from the slums, an agitation may result that shall lead a city to construct tenement-houses as it now does its school-houses.* The question is sure to arise, What shall be done with the incompetent, though not necessarily vicious or intemperate? They must not be allowed to starve, surely not; but it is to be observed that, when such incompetents tumble overboard, they make strenuous efforts to save themselves, and if caught in a burning building they appear active, even boisterous, in their attempts to escape. The simplest manual labor is within their power, and for this they should be paid; their chances for quality of food, quantity of tobacco, etc., should depend upon their efforts to help themselves. If they will not work, and insist upon being vagabonds, they come under cognizance of the law, and

* The pauper, the imbecile, the lunatic, and in some cities those afflicted in other ways, are provided for in appropriate public institutions.

their liberty may be abridged, and for an indefinite time if need be. By this curtailment of their freedom *their line of descent is arrested*, and this is the important object to accomplish. In a very inadequate manner, but with illustrations familiar to all, Nature's way has been appealed to as worthy of trial. This is the ringing lesson of natural selection as applied to this great problem, and we commend it, in all earnestness, to those who have the welfare of the submerged classes at heart.

NEW CHAPTERS IN THE WARFARE OF SCIENCE.

XVII.—GEOGRAPHY.

By ANDREW DICKSON WHITE, LL.D., L.H.D.,
EX-PRESIDENT OF CORNELL UNIVERSITY.

PART I.

1. The Form of the Earth.—Among various rude tribes we find survivals of a primitive idea that the earth is a flat table or disk, ceiled, domed, or canopied by the sky, and that the sky rests upon the mountains as pillars. Such a belief is entirely natural; it conforms to the appearance of things, and hence has entered into various theologies.

In the early civilizations of Egypt and Chaldea it was very fully developed. The Egyptians considered the earth as a table, flat and oblong, the sky being its ceiling; a huge "firmament" of metal. At the four corners of the earth were the pillars supporting this firmament, and on this solid sky were the "waters above the heavens." They believed that, when chaos was taking form, one of the gods by main force raised the waters on high and spread them out over the firmament; that on the under side of this solid vault or ceiling or firmament the stars were suspended to light the earth, and that the rains were caused by the letting down of the waters through its windows. This idea and others connected with it seem to have taken strong hold of the Egyptian priestly caste, thus entering into their theology and sacred science: ceilings of great temples, with stars, constellations, planets, and signs of the zodiac figured upon them, remain to-day as striking evidences of this.

In India and Persia we have theories of geography based upon similar conceptions and embalmed in sacred texts. The Chaldeans also believed that a firmament was spread out over the earth, and that it supported the ocean of celestial waters, from which fell dew and rain.

From these sources came geographical legacies to the Hebrews:

various passages in their sacred books, many of them most noble in conception, and most beautiful in form, regarding the "firmament," the "corners of the earth," the "pillars of heaven," the "waters above the firmament," and the "windows of heaven," point us back to these ancient springs of thought.*

But as civilization was developed, there were evolved, especially among the Greeks, ideas of the earth's sphericity. The Pythagoreans, Plato, and Aristotle especially cherished them. These ideas were vague, they were mixed with absurdities, but they were germ ideas, and even amid the luxuriant growth of theology in the early Christian Church these germs began struggling into life in the minds of a few thinking men, and these men renewed the suggestion that the earth is a globe.†

A few of the larger-minded fathers of the Church, influenced possibly by Pythagorean traditions, but certainly by Aristotle and Plato, were willing to accept this view, but the majority of them took fright at once. To them it seemed fraught with dangers to Scripture, by which, of course, they meant *their inter-*

* For survivals of the early idea, among the Eskimos, of the sky as supported by mountains, and, among sundry Pacific islanders, of the sky as a firmament or vault of stone, see Tylor, Early History of Mankind, second edition, London, 1870, chap. xi; Spencer, Sociology, vol. i, chap. viii; also Andrew Lang, La Mythologie, Paris, 1886, pp. 68–73. For the early view in India and Persia, see citations from the Vedas and the Zend-Avesta in Lethaby, Architecture, Mysticism, and Myth, chap. i. For the Egyptian view, see Champollion; also, Lenormant, Histoire Ancienne, Maspero, and others. As to the figures of the heavens upon the ceilings of Egyptian temples, see Maspero, Archéologie Egyptienne, Paris, 1890; and for engravings of them, see Lepsius, Denkmäler, vol. i, Bl. 41, and vol. ix, Abth. iv, Bl. 35; also the Déscription de l'Égypte published by order of Napoleon, tome ii, Pl. 14; also Prisse d'Avennes, Art Égyptien, Atlas, tome i, Pl. 35; and especially for a survival at the Temple of Denderah, see Denon, Voyage en Égypte, Planches 129, 130. For the Egyptian idea of "pillars of heaven," as alluded to on the stele of Victory of Thotmes III, in the Cairo Museum, see Ebers, Uarda, ii, 175, note, Leipsic, 1877. For a similar Babylonion belief, see Sayce's Herodotus, Appendix, 403. For the belief of Hebrew scriptural writers in a solid "firmament," see especially Job, xxxviii, 18; also Smith's Bible Dictionary.

† The agency of the Pythagoreans in first spreading the doctrine of the earth's sphericity is generally acknowledged, but the first clear and full utterance of it to the world was by Aristotle. Very fruitful, too, was the statement of the new theory given by Plato in the Timæus; see Jowett's translation, New York edition, 62, c. Also Phædo, pp. 449 *et seq.* See also Grote on Plato's doctrine of the sphericity of the earth; also Sir G. C. Lewis's Astronomy of the Ancients, London, 1862, chap. iii, section i, and note. Cicero's mention of the antipodes, and his reference to the passage in the Timæus are even more remarkable than the original, in that they much more clearly foreshadow the modern doctrine. See his Academic Questions, ii; also Tusc. Quest., i and v, 24. For a very full summary of the views of the ancients on the sphericity of the earth, see Kretchmer, Die physische Erdkunde im christlichen Mittelalter, Wien, 1889, pp. 35 *et seq.*; also, Eicken, Geschichte der mittelälterlichen Weltanschauung, Stuttgart, 1887, Dritter Theil, chap. vi. For citations and summaries, see Whewell, Hist. Induct. Sciences, vol. i, p. 189, and St. Martin, Hist. de la Géog., Paris, 1873, p. 96; also, Leopardi, Saggio sopra gli errori popolari degli antichi, Firenze, 1851, chapter xii, pp. 184 *et seq.*

pretation of Scripture. Among the first who took up arms against it was Eusebius. In view of the New Testament texts indicating the immediately approaching end of the world, he endeavored to turn off this idea by bringing scientific studies into contempt. Speaking of investigators, he said, "It is not through ignorance of the things admired by them, but through contempt of their useless labor, that we think little of these matters, turning our souls to better things." Basil of Cæsarea declared it "a matter of no interest to us whether the earth is a sphere or a cylinder or a disk, or concave in the middle like a fan." Lactantius referred to the ideas of those studying astronomy as "bad and senseless," and opposed the doctrine of the earth's sphericity both from Scripture and reason. St. John Chrysostom also exerted his influence against this scientific belief; and Ephrem Syrus, the greatest man of the old Syrian Church, widely known as the "lute of the Holy Ghost," opposed it no less earnestly.

But the strictly Biblical men of science, such eminent fathers and bishops as Theophilus of Antioch in the second century, Clement of Alexandria in the third, and others in centuries following, were not content with merely opposing what they stigmatized as an old heathen theory; they drew from their Bibles a new Christian theory, to which one church authority added one idea and another another, until it was fully developed. Taking the survival of various early traditions, given in the seventh verse of the first chapter of Genesis, they dwelt on the scriptural declaration that the earth was, at creation, arched over with a solid vault, "a firmament," and to this they added the passage from Isaiah in which it is declared that the heavens are stretched out "like a curtain," and again "like a tent to dwell in." The universe, then, is like a house: the earth is its ground floor, the firmament its ceiling, under which the Almighty hangs out the sun to rule the day, and the moon and stars to rule the night. This ceiling is also the floor of the apartment above, and in this is a cistern, shaped, as one of the authorities says, "like a bathing-tank," and containing "the waters which are above the firmament." These waters are let down upon the earth by the Almighty and his angels through the "windows of heaven." As to the movement of the sun, there was a citation of various passages in Genesis, mixed with metaphysics in various proportions, and this was thought to give ample proofs from the Bible that the earth could not be a sphere.*

* For Eusebius, see the Præp. Ev., xv, 61. For Basil, see the Hexameron, Hom. ix, cited in Peschel, Erdkunde, p. 96, note. For Lactantius, see his Inst. Div., lib. iii, cap. 3; also, citations in Whewell, Hist. Induct. Sciences, London, 1857, vol. i, p. 194, and in St. Martin, Histoire de la Géographie, pp. 216, 217. For the views of St. John Chrysostom Eph. Syrus, and other great churchmen, see Kretschmer as above, chap. i.

In the sixth century this development of theory culminated in what was nothing less than a complete and detailed system of the universe, claiming to be based upon Scripture, its author being the Egyptian monk Cosmas Indicopleustes. Egypt was a great treasure-house of theologic thought to various religions of antiquity, and Cosmas appears to have urged upon the early Church this Egyptian idea of the construction of the world, just as another Egyptian ecclesiastic, Athanasius, urged upon the Church the Egyptian triune idea of the gods ruling the world. According to Cosmas, the earth is a parallelogram, flat, and surrounded by four seas. It is four hundred days' journey long and two hundred broad. At the outer edges of these four seas arise massive walls closing in the whole structure and supporting the firmament or vault of the heavens, whose edges are cemented to the walls. These walls inclose the earth and all the heavenly bodies.

The whole of this theologic-scientific structure was built most carefully and, as was then thought, most scripturally. Starting with the expression applied in the ninth chapter of Hebrews to the tabernacle in the desert, Cosmas insists, with other interpreters of his time, that it gives the key to the whole construction of the world. The universe is, therefore, made on the plan of the Jewish tabernacle—box-like and oblong. Going into details, he quotes the sublime words of Isaiah: "It is He that sitteth upon the circle of the earth; . . . that stretcheth out the heavens like a curtain, and spreadeth them out like a tent to dwell in"; and the passage in Job, which speaks of the "pillars of heaven." He works all this into his system, and reveals, as he thinks, treasures of science.

This vast box is divided into two compartments, one above the other. In the first of these, men live and stars move; and it extends up to the first solid vault, or firmament, above which live the angels, a main part of whose business it is to push and pull the sun and planets to and fro. Next, he takes the text, "Let there be a firmament in the midst of the waters, and let it divide the waters from the waters," and other texts from Genesis; to these he adds the text from the Psalms, "Praise him, ye heaven of heavens, and ye waters that be above the heavens"; then casts all these growths of thought into his crucible together, and finally brings out the theory that over this first vault is a vast cistern containing "the waters." He then takes the expression in Genesis regarding the "windows of heaven" and establishes a doctrine regarding the regulation of the rain, to the effect that the angels not only push and pull the heavenly bodies to light the earth, but also open and close the heavenly windows to water it.

To understand the surface of the earth, Cosmas studies the table of show-bread in the Jewish tabernacle. The surface of this

table proves to him that the earth is flat, and its dimensions prove that the earth is twice as long as broad; its four corners symbolize the four seasons; the twelve loaves of bread, the twelve months; the hollow about the table proves that the ocean surrounds the earth. To account for the movement of the sun, Cosmas suggests that at the north of the earth is a great mountain, and that at night the sun is carried behind this; but some of the commentators ventured to express a doubt here; they thought that the sun was pushed into a great pit at night and pulled out in the morning.

Nothing can be more touching in its simplicity than Cosmas's summing up of his great argument. He declares, "We say therefore with Isaiah that the form of the heaven that embraces the universe is that of a vault, with Job that it is joined to the earth, and with Moses that the length of the earth is greater than its breadth." The treatise closes with rapturous assertions that not only Moses and the prophets, but also angels and apostles, agree to the truth of his doctrine, and that at the last day God will condemn all who do not accept it.

Although this theory was universally considered as drawn from Scripture, it was really, as we have seen, the result of an evolution of theological thought begun long before the texts on which it nominally rested were written. It was not at all strange that Cosmas, Egyptian as he was, should have received this old Nile-born doctrine, as we see it indicated to-day in the structure of Egyptian temples, and that he should have developed it by the aid of the Jewish Scriptures. But the theological world knew nothing of its more remote pagan evolution; it was received as virtually inspired, and was soon regarded as a fortress of scriptural truth. Some of the foremost men in the Church devoted themselves to buttressing it with new texts and throwing about it new outworks of theological reasoning; the great body of the faithful considered it a direct gift from the Almighty.*

---

* For a notice of the views of Cosmas in connection with those of Lactantius, Augustine, St. John Chrysostom, and others, see Schoell, Histoire de la Littérature Grecque, vol. vii, p. 37. The main scriptural passages referred to are as follows: (1) Isaiah xl, 22; (2) Genesis i, 6; (3) Genesis vii, 11; (4) Exodus xxiv, 10; (5) Job xxvi, 11, and xxxvii, 18; (6) Psalm cxlviii, 4, and civ, 9; (7) Ezekiel i, 22–26. For Cosmas's theory see Montfaucon, Collectio Nova Patrum, Paris, 1706, vol. ii, p. 188; also pp. 298, 299. The text is illustrated with engravings showing walls and solid vault (firmament), with the whole apparatus of "fountains of the great deep," "windows of heaven," angels, and the mountain behind which the sun is drawn. For reduction of one of them see Peschel, Geschichte der Erdkunde, p. 98; also article "Maps," in Knight's Dictionary of Mechanics, New York, 1875. For a good discussion of Cosmas's ideas, see Santarem, Hist. de la Cosmographie, vol. ii, pp. 8 *et seq.*, and for a very thorough discussion of its details, Kretschmer, as above. For still another theory, very droll, and thought out on similar principles, see Mungo Park, cited in De Morgan, Paradoxes, 309. For Cosmas's joyful summing up, see Montfaucon,

From this old conception of the universe as a sort of house, with heaven as its upper story and the earth as its ground floor, flowed important theological ideas into heathen, Jewish, and Christian mythologies. Common to them all are legends regarding attempts of mortals to invade the upper apartment from the lower. Of such are the Greek legends of the Aloidae who sought to reach heaven by piling up mountains, and were cast down; the Chaldean and Hebrew legends of the wicked who at Babylon sought to build "a tower whose top may reach heaven," which Jehovah went down from heaven to see, and which he brought to naught by the "confusion of tongues"; the Hindoo legend of the tree which sought to grow into heaven and which Brahma blasted; and the Mexican legend of the giants who sought to reach heaven by building the Pyramid of Cholula, and who were overthrown by fire from above.

Myths having this geographical idea as their germ developed in luxuriance through thousands of years. Ascensions to heaven and descents from it, "translations," "assumptions," "annunciations," mortals "caught up" into it and returning, angels flying between it and the earth, thunderbolts hurled down from it, mighty winds issuing from its corners, voices speaking from the upper floor to men on the lower, temporary openings of the floor of heaven to reveal the blessedness of the good, "signs and wonders" hung out from it to warn the wicked, interventions of every kind, from the heathen gods coming down on every sort of errand, and Jehovah coming down to walk in Eden in the cool of the day, to St. Mark swooping down into the market-place of Venice to break the shackles of a slave—all these are but features in a vast evolution of myths arising largely from this geographical germ.

Nor did this evolution end here. Naturally, in this view of things, if heaven was a loft, hell was a cellar; and if there were ascensions into one, there were descents into the other. Hell being so near, interferences by its occupants with the dwellers of the earth just above were constant and form a vast chapter in mediæval literature. Dante made this conception of the location of hell still more vivid, and we find some forms of it serious barriers to geographical investigation. Many a bold navigator, who was quite ready to brave pirates and tempests, trembled at the thought of tumbling with his ship into one of the openings into hell which a wide-spread belief placed in the Atlantic at some unknown distance from Europe. This terror of the sailors was one of the main obstacles in the great voyage of Columbus. In an

---

Collectio Nova Patrum, vol. ii, p. 255. For the Egyptian Trinitarian views, see Sharpe, History of Egypt, vol. i, pp. 94, 102.

Anglo-Saxon tract, giving science the form of a dialogue, occur the following question and answer: "Why is the sun so red in the evening?" "Because he looketh down upon hell."

But the ancient germ of scientific truth in geography still lived, and a hundred years after Cosmas it gets new life from a great churchman of southern Europe, Isidore of Seville, who, however fettered by the dominant theology in many other things, braved it in this. In the eighth century a similar declaration is made in the north of Europe by another great church authority, Bede. Against the new life thus given to the old truth, the sacred theory struggled long and vigorously but in vain. Eminent authorities in later ages, like Albert the Great, St. Thomas Aquinas, Dante, and Vincent of Beauvais, felt obliged to accept the doctrine of the earth's sphericity, and as we approach the modern period we find its truth acknowledged by the vast majority of thinking men.*

2. THE DELINEATION OF THE EARTH.—Every great people of antiquity, as a rule, regarded its own central city or most holy place as necessarily the center of the earth.

The Chaldeans held that their "holy house of the gods" was the center. The Egyptians sketched the world under the form of a human figure, in which Egypt was the heart, and the center of it, Thebes. For the Assyrians, it was Babylon; for the Hindoos, it was Mount Meru; for the Greeks, so far as the civilized world was concerned, Olympus or the temple at Delphi; for the modern Mohammedans, it is Mecca and its sacred stone; the Chinese, to this day, speak of their empire as the "middle kingdom." It was in accordance, then, with a simple tendency of human thought that the Jews believed the center of the world to be Jerusalem.

The book of Ezekiel speaks of Jerusalem as in the middle of the earth, and all other parts of the world as set around the holy city. Throughout the "ages of faith" this was very generally accepted as a direct revelation from the Almighty regarding the earth's form. St. Jerome, the greatest authority of the early Church upon the Bible, declared, on the strength of this utterance of the prophet, that Jerusalem must stand at the earth's center; in the ninth century Archbishop Rabanus Maurus reiterated the same argument; in the eleventh century, Hugh of St. Victor gave to the doctrine another scriptural demonstration; and Pope Urban, in his great sermon at Clermont urging the Franks to the crusade, declared, "Jerusalem is the middle point of the earth";

* For a discussion of the geographical views of Isidore and Bede, see Santarem, Cosmographie, vol. i, pp. 22–24. For the gradual acceptance of the idea of the earth's sphericity after the eighth century, see Kretschmer, pp. 51 *et seq.*, where citations from a multitude of authors are given.

in the thirteenth century, another of the mediæval Church authorities, Cæsar of Heisterbach, declared, "As the heart in the midst of the body, so is Jerusalem situated in the midst of our inhabited earth"; "so it was that Christ was crucified at the center of the earth." Dante accepted this view of Jerusalem as a certainty and wedded it to immortal verse.

Ezekiel's statement thus became the standard of orthodoxy to early map-makers. The map of the world at Hereford Cathedral, the maps of Andrea Bianco, Marino Sanuto, and a multitude of others fixed this view in men's minds, and doubtless helped during many generations to discourage any scientific statements tending to unbalance this geographical center supposed to be revealed in Scripture.*

Nor did mediæval thinkers rest with this conception. In accordance with the dominant view that physical truth must be sought by theological reasoning, the idea was evolved that not only the site of the cross on Calvary marked the geographical center of the world, but that on this very spot had stood the tree which bore the forbidden fruit in Eden. Thus was geography made to reconcile all parts of the great theologic plan. This doctrine was hailed with joy by multitudes; and we find in the works of mediæval pilgrims to Palestine, again and again, evi-

---

* For the beliefs of various nations of antiquity that the earth's center was in their most sacred place, see citations from Maspero, Charton, Sayce, and others in Lethaby, Architecture, Mysticism, and Myth, chap. iv. As to the Greeks, we have typical statements in the Eumenides of Æschylus, where the stone on the altar at Delphi is repeatedly called "the earth's navel"—which is precisely the expression used regarding Jerusalem in the Septuagint translation of Ezekiel (see note below). The proof texts on which the mediæval geographers mainly relied as to the form of the earth were Ezekiel, v, 5, and xxxviii, 12. The progress of geographical knowledge evidently caused them to be softened down somewhat in our King James's version; but the first of them reads, in the Vulgate, "*Ista est Hierusalem, in medio gentium posui eam et in circuitu ejus terræ*"; and the second reads, in the Vulgate, "*in medio terræ*," and in the Septuagint, ἐπὶ τὸν ὀμφαλὸν τῆς γῆς. That the literal center of the earth was understood, see proof in St. Jerome, Commentar. in Ezekiel, lib. ii; and for general proof, see Leopardi, Saggio sopra gli errori popolari degli antichi, pp. 207, 208. For Rabanus Maurus, see his De Universo, lib. xii, cap. 4, in Migne, tome cxi, p. 339. For Hugh of St. Victor, see his De Situ Terrarum, cap. ii. For Dante's belief, see Inferno, canto xxxiv, 112–115:

"E se' or sotto l'emisperio giunto,
Ch' è opposito a quel che la gran secca
Coverchia, e sotto il cui colmo consunto
Fu l'uom che nacque e visse senza pecca."

For orthodox geography in the middle ages, see Wright's Essays on Archæology, vol. ii, chapter on the map of the world in Hereford Cathedral; also the rude maps in Cardinal d'Ailly's Ymago Mundi; also copy of maps of Marino Sanuto and others in Peschel, Erdkunde, p. 210; also Münster, Fac Simile dell' Atlante de Andrea Bianco, Venezia, 1869. And for discussions of the whole subject, see Santarem, vol. ii, p. 295, vol. iii, pp. 71, 183, 184, and elsewhere. For a brief summary with citations, see Eicken, Geschichte, etc., pp. 622, 623.

dence that this had become precious truth to them, both in theology and geography.*

Nor was this the only misconception which forced its way from our sacred writings into mediæval map-making; two others were almost as marked.

First of these was the vague terror inspired by Gog and Magog. Few passages in the Old Testament are more sublime than the denunciation of these great enemies by Ezekiel; and the well-known statement in the Apocalypse fastened the Hebrew feeling regarding them with a new meaning into the mind of the early Church: hence it was that the mediæval map-makers took great pains to delineate these monsters and their habitations on the maps. For centuries no map was considered orthodox which did not show them.

The second conception was derived from the frequent mention in our sacred books of the "four winds." Hence came a vivid belief in their real existence and their delineation on the maps, generally as colossal heads with distended cheeks, blowing vigorously toward Jerusalem.

Even at a period after these conceptions had mainly disappeared we find here and there evidences of the difficulty men found in giving up the scriptural idea of direct personal interference by agents of Heaven in the ordinary phenomena of Nature: thus in a noted map of the sixteenth century representing the earth as a sphere, there is at each pole a crank, with an angel laboriously turning the earth by means of it.†

---

* For the site of the cross on Calvary, as the point where stood "the tree of the knowledge of good and evil" in Eden, at the center of the earth, see various Eastern travelers cited in Tobler; but especially the travels of Bishop Arculf in the Holy Land in Wright's Early Travels in Palestine, p. 8; also, Travels of Saewulf, ibid., p. 38; also, Sir John Maundeville, ibid., pp. 166, 167; and for one narrative in which the idea was developed into an amazing mass of pious myths, see Pilgrimage of the Russian Abbot Daniel, edited by Sir C. W. Wilson, London, 1885, p. 14. (The passage deserves to be quoted as an example of myth-making; it is as follows: "At the time of our Lord's crucifixion, when he gave up the ghost on the cross, the veil of the temple was rent, and the rock above Adam's skull opened, and the blood and water which flowed from Christ's side ran down through the fissure upon the skull, thus washing away the sins of men.")

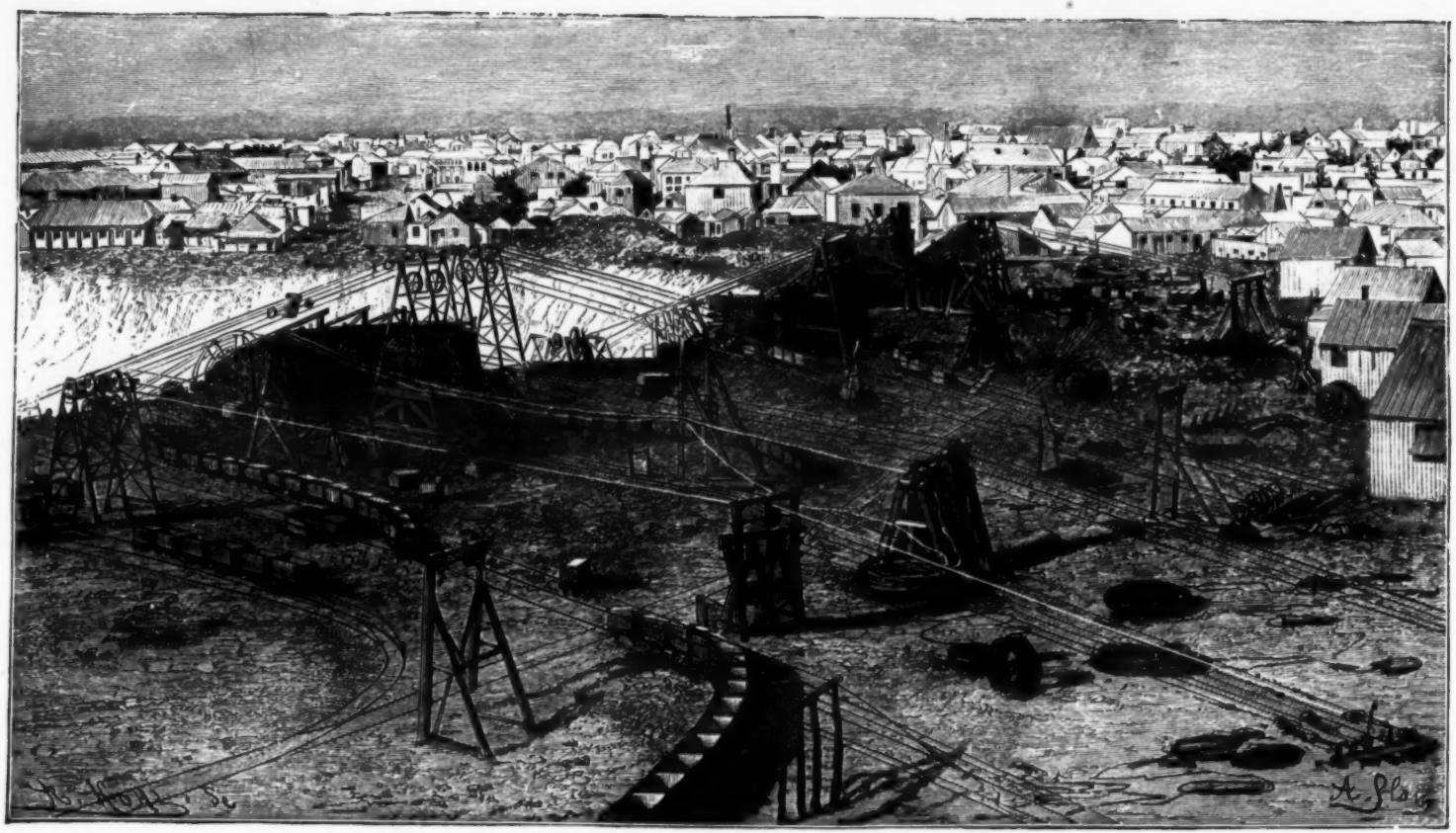
† For Gog and Magog, see Ezekiel, chaps. xxxviii and xxxix, and Rev. xx, 8; and for the general subject, Toy, Judaism and Christianity, Boston, 1891, pp. 373, 374. For maps showing these two great terrors, and for geographical discussion regarding them, see Lelewel, Géog. du Moyen Age, Bruxelles, 1850, Atlas; also Ruge, Gesch. des Zeitalters der Entdeckungen, Berlin, 1881, pp. 78, 79; also Peschel's Abhandlungen, pp. 28–35, and Gesch. der Erdkunde, p. 210. For representations on maps of the "Four Winds," see Charton, Voyageurs, tome ii, p. 11; also Ruge as above, pp. 324, 325; also, for a curious mixture of the scriptural four winds with the classical winds issuing from the bags of Æolus, see a map of the twelfth century in Léon Gautier, La Chevalerie, p. 153; and for maps showing additional winds, see various editions of Ptolemy. For a map with angels turning the earth by means of cranks at the poles, see Grynæus, Novus Orbis, Basileæ, 1537.

THE DIAMOND INDUSTRY AT KIMBERLEY.*

By LORD RANDOLPH CHURCHILL.

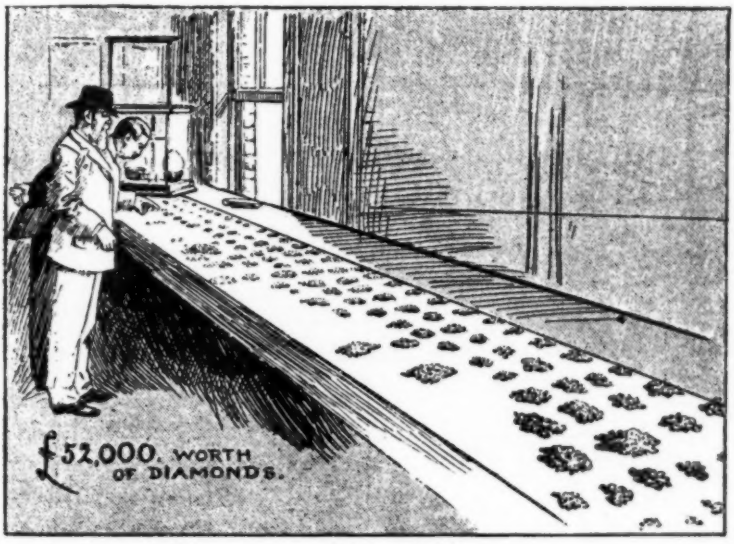
NOTHING in the external appearance of Kimberley suggests either its fame or its wealth. A straggling, hap-hazard connection of small, low dwellings, constructed almost entirely of corrugated iron or of wood, laid out with hardly any attempt at regularity, and without the slightest trace of municipal magnificence, is the home of the diamond industry. It seems that when the diamonds were first discovered, some twenty years ago, many thousands of persons settled down suddenly on the spot like a cluster of swarming bees, and established themselves anyhow as best they could in the most rough and primitive fashion, never dreaming but that the yield of diamonds would be of limited extent and of short duration, that their fortunes would be rapidly acquired, and that they would pass as rapidly away from the place, having exhausted all its wealth-producing resources. The reverse has proved to be the case. The diamondiferous resources of Kimberley are now known to be practically inexhaustible, but the amalgamation of the mines has restricted employment and checked immigration, and the town still preserves, and probably will always preserve, its transitory and rough-and-ready appearance. There are, however, a number of excellent shops, and there are few articles of necessity, of convenience, or of luxury which can not here be purchased. A most comfortable and hospitable club, an admirably laid-out and well-arranged race-course testify to the thoroughly English character of the settlement. At Kimberley the diamond is everything, and the source and method of its production claim more than a passing mention. My first visit was to the offices of the De Beers Company, which company represents the amalgamated interests of the De Beers, Kimberley, Bultfontein, Du Toits Pan, and other smaller mines. The amalgamation was the work of Mr. Cecil Rhodes, and it was this great work, accomplished in the teeth of unheard-of difficulties and almost insurmountable opposition, representing the conciliation and unification of almost innumerable rival jarring and conflicting interests, which revealed to South Africa that it possessed a public man of the first order. The scale of the company's operations is stupendous. On a capital of nearly £8,000,000 of debenture and share stock it has paid, since its formation in 1888 up to March, 1890, interest at the rate of 5½ per cent, and an annual dividend of 20 per cent. In the same period it has given out some 2,500,000

* From Men, Mines, and Animals of South Africa. By Lord Randolph Churchill. New York: D. Appleton & Co., 1892.



KIMBERLEY AND ITS DIAMOND MINE. (From Reclus's The Earth and its Inhabitants.)

carats of diamonds, realizing by sale over £3,500,000, produced by washing some 2,700,000 loads of blue ground. Each load represents three quarters of a ton, and costs in extracting about 8*s*. 10*d*. per load, realizing a profit of 20*s*. to 30*s*. per carat sold. The annual amount of money paid away in interest and dividends exceeds £1,300,000. The dividends might have been much larger, but the

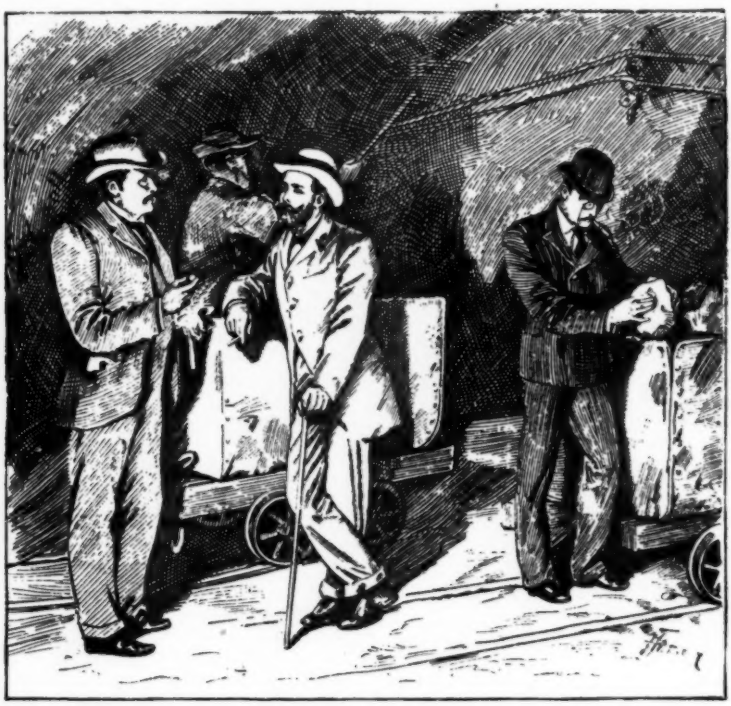


CLASSIFIED FOR SHIPMENT AT KIMBERLEY.

policy of the present board of directors appears to be to restrict the production of diamonds to the quantity the world can easily absorb, to maintain the price of the diamonds at a fair level from 28*s*. to 32*s*. per carat, and, in order the better to carry out this policy, to accumulate a very large cash reserve. I believe that the reserve already accumulated amounts to nearly £1,000,000, and that this amount is to be doubled in the course of the next year or two, when the board will feel that they have occupied for their shareholders a position unassailable by any of the changes and chances of commerce. In the working of the mine there are employed about 1,300 Europeans and 5,700 natives. The wages paid range high, and figures concerning them may interest the English artisan. Mechanics and engine-drivers receive from £6 to £7 per week, miners from £5 to £6, guards and tally-men from £4 to £5; natives in the underground works are paid from 4*s*. to 5*s*. per day. In the work on the "floors," which is all surface work, overseers receive from £3 12*s*. to £4 2*s*., machine-men and assorters from £5 to £6, and ordinary native laborers from 17*s*. 6*d*. to 21*s*. per week. In addition, every employé on the "floors" has a percentage on the value of diamonds found by himself, the white employés re-

ceiving 1*s.* 6*d.*, and the natives 3*d.*, per carat. Nearly double these amounts are paid for stones found in the mines.

Mr. Gardner Williams, the eminent mining engineer who occupies the important post of general manager to the De Beers Company, was kind enough to accompany me all over the mines, and to explain in detail the method of operation. The De Beers and the Kimberley mines are probably the two biggest holes which greedy man has ever dug into the earth, the area of the former at the surface being thirteen acres, with a depth of 450 feet, the area and depth of the latter being even greater. These mines are no



Mr. Gardner Williams. Lord Randolph Churchill. Captain Williams.

IN THE ROCK SHAFT OF THE DE BEERS DIAMOND MINE AT A DEPTH OF NINE HUNDRED FEET.

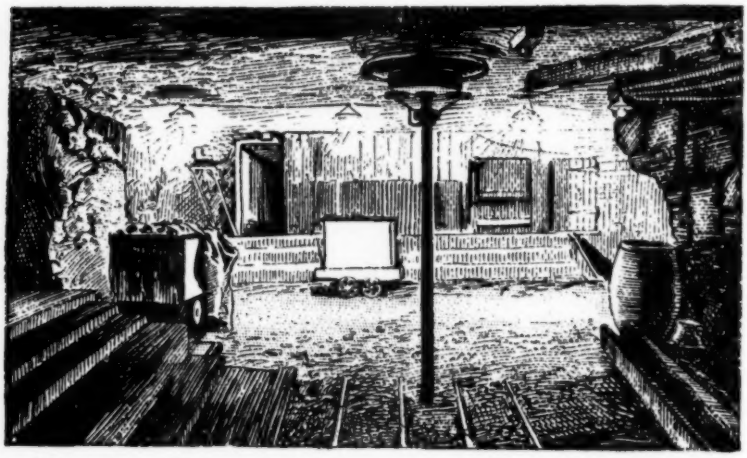
longer worked from the surface, but from shafts sunk at some distance from the original holes, and penetrating to the blue ground by transverse drivings at depths varying from 500 to 1,200 feet. The blue ground, when extracted, is carried in small iron trucks to the "floors." "These are made by removing the bush and grass from a fairly level piece of ground; the land is then rolled and made as hard and as smooth as possible. These 'floors' are about 600 acres in extent. They are covered to the depth of about a foot with the blue ground, which for a time remains on them without much manipulation. The heat of the sun and

moisture soon have a wonderful effect upon it. Large pieces which were as hard as ordinary sandstone when taken from the mine, soon commence to crumble. At this stage of the work, the winning of the diamonds assumes more the nature of farming than of mining; the ground is continually harrowed to assist pulverization by exposing the larger pieces to the action of the sun and rain. The blue ground from Kimberley mine becomes quite well pulverized in three months, while that from De Beers requires double that time. The longer the ground remains exposed, the better it is for washing."* The process of exposure being completed, the blue ground is then carried to very large, elaborate, and costly washing machines, in which, by means of the action of running water, the diamonds are separated from the ordinary earth. It may be mentioned that in this process one hundred loads of blue ground are concentrated into one load of diamondiferous stuff. Another machine, the "pulsator," then separates this latter stuff, which appears to be a mass of blue and dark pebbles of all shapes, into four different sizes, which then pass on to the assorters. "The assorting is done on tables, first while wet by white men, and then dry by natives."† The assorters work with a kind of trowel, and their accuracy in detecting and separating the diamond from the eight different kinds of mineral formations which reach them is almost unerring. "The diamond occurs in all shades of color from deep yellow to a blue white, from deep brown to light brown, and in a great variety of colors, green, blue, pink, brown, yellow, orange, pure white, and opaque."‡ The most valuable are the pure white and the deep orange. "The stones vary in size from that of a pin's head upward; the largest diamond yet found weighed 428½ carats. It was cut and exhibited at the Paris Exhibition, and after cutting weighed 228½ carats. "After assorting, the diamonds are sent daily to the general office under an armed escort and delivered to the valuators in charge of the diamond department. The first operation is to clean the diamonds of any extraneous matter by boiling them in a mixture of nitric and sulphuric acids. When cleaned they are carefully assorted again in respect of size, color, and purity."# The room in the De Beers office where they are then displayed offers a most striking sight. It is lighted by large windows, underneath which runs a broad counter covered with white sheets of paper, on which are laid out innumerable glistening heaps of precious stones of indescribable variety. In this room are concentrated some 60,000 carats, the daily production of the Consolidated Mine being about 5,500 carats. "When the diamonds have been valued they are sold in parcels to local buyers, who represent the leading

* Report, 1890, General Manager, De Beers. † Ibid. ‡ Ibid. # Ibid.

diamond merchants of Europe. The size of a parcel varies from a few thousand to tens of thousands of carats; in one instance, two years ago, nearly a quarter of a million of carats were sold in one lot to one buyer." *

The company sustain a considerable loss annually, estimated now at from 10 to 15 per cent, by diamonds being stolen from the mines. To check this loss, extraordinary precautions have been resorted to. The natives are engaged for a period of three months, during which time they are confined in a compound surrounded by a high wall. On returning from their day's work, they have to strip off all their clothes, which they hang on pegs in a shed. Stark naked, they then proceed to the searching-room, where their mouths, their hair, their toes, their armpits, and every

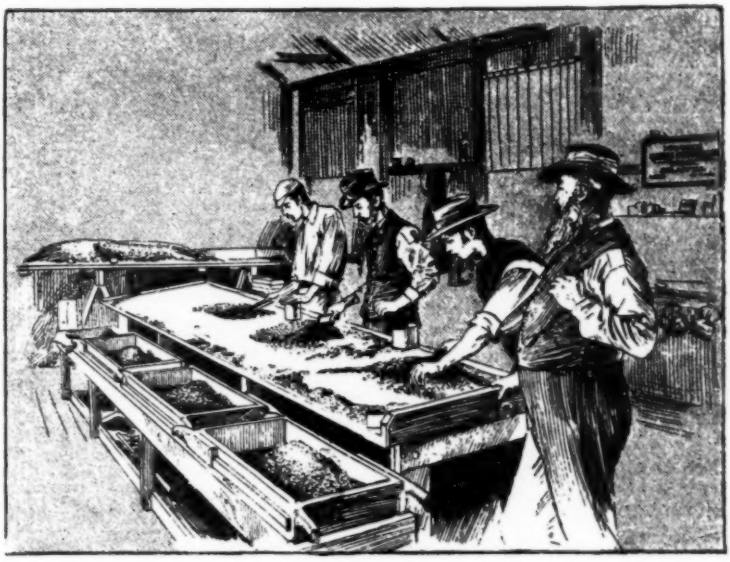


IN THE EIGHT-HUNDRED-FEET LEVEL OF THE DE BEERS DIAMOND MINE.

portion of their bodies are subjected to an elaborate examination. White men would never submit to such a process, but the native sustains the indignity with cheerful equanimity, considering only the high wages which he earns. After passing through the searching-room, they pass, still in a state of nudity, to their apartments in the compound, where they find blankets in which to wrap themselves for the night. During the evening the clothes which they have left behind them are carefully and minutely searched, and are restored to their owners in the morning. The precautions which are taken a few days before the natives leave the compound, their engagement being terminated, to recover diamonds which they may have swallowed, are more easily imagined than described. In addition to these arrangements, a law of exceptional rigor punishes illicit diamond buying, known in

* Report, 1890, General Manager, De Beers.

the slang of South Africa as I. D. B.ism. Under this statute, the ordinary presumption of law in favor of the accused disappears, and an accused person has to prove his innocence in the clearest manner, instead of the accuser having to prove his guilt. Sentences are constantly passed on persons convicted of this offense ranging from five to fifteen years. It must be admitted that this tremendous law is in thorough conformity with South African sentiment, which elevates I. D. B.ism almost to the level, if not above the level, of actual homicide. If a man walking in the streets or in the precincts of Kimberley were to find a diamond and were not immediately to take it to the registrar, restore it to him, and to have the fact of its restoration registered, he would be liable to a punishment of fifteen years' penal servitude. In order to prevent illicit traffic, the quantities of diamonds produced by the mines are reported to the detective department both



SORTING GRAVEL FOR DIAMONDS AT KIMBERLEY.

by the producers and the exporters. All diamonds, except those which pass through illicit channels, are sent to England by registered post, the weekly shipments averaging from 40,000 to 50,000 carats. The greatest outlet for stolen diamonds is through the Transvaal to Natal, where they are shipped by respectable merchants, who turn a deaf ear to any information from the diamond fields to the effect that they are aiding the sale of stolen property.* The most ingenious ruses are resorted to by the illicit

* Report, 1890, General Manager, De Beers.

dealers for conveying the stolen diamonds out of Kimberley. They are considerably assisted by the fact that the boundaries of the Transvaal and of the Free State approach within a few miles of Kimberley, and once across the border they are comparatively safe. Recently, so I was informed, a notorious diamond thief was seen leaving Kimberley on horseback for the Transvaal. Convinced of his iniquitous designs, he was seized by the police on the border and thoroughly searched. Nothing was found on him, and he was perforce allowed to proceed. No sooner was he well across the border, than he, under the eyes of the detective, deliberately shot and cut open his horse, extracting from its intestines a large parcel of diamonds, which, previous to the journey, had been administered to the unfortunate animal in the form of a ball.

The De Beers directors manage their immense concern with great liberality. A model village, called Kenilworth, within the precincts of the mines, affords most comfortable and healthy accommodation for several of the European employés. Gardens are attached to cottages, and the planting of eucalyptus, cypress, pine, and oak, as well as a variety of fruit trees, has been carried to a considerable extent. A very excellent club-house has also been built, which includes, besides the mess-room and kitchen, a reading-room, where many of the monthly papers and magazines are kept, together with six hundred volumes from the Kimberley Public Library. There is also a billiard-room, with two good tables given by two of the directors. A large recreation-ground is in the course of construction. Within the compound where the native laborers are confined is a store where they can procure cheaply all the necessaries of life. Wood and water are supplied free of charge, and a large swimming-bath is also provided, but I did not learn if the natives made much use of it. All sick natives are taken care of in a hospital connected with the compound, where medical attendance, nurses, and food are supplied gratuitously by the company. I should not omit to mention that the entire mine, above and under ground, is lighted by electricity. There are ten circuits of electric lamps for De Beers and Kimberley mines. They consist of fifty-two arc lamps of 1,000 candle-power each, and 691 glow lamps of sixteen and sixty-four candle-power each, or a total illuminating power of 63,696 candles. There are, moreover, thirty telephones connecting the different centers of work together, and over eighty electric bells are used for signaling in shafts and on haulages. Such is this marvelous mine, the like of which I doubt whether the world can show. When one considers the enormous capital invested, the elaborate and costly plant, the number of human beings employed, and the object of this unparalleled concentration of effort, curious reflec-

tions occur. In all other mining distinctly profitable objects are sought, and purposes are carried out beneficial generally to mankind. This remark would apply to gold mines, to coal mines, to tin, copper, and lead mines; but at the De Beers mine all the wonderful arrangements I have described above are put in force in order to extract from the depths of the ground, solely for the wealthy classes, a tiny crystal to be used for the gratification of female vanity in imitation of a lust for personal adornment essentially barbaric if not altogether savage.

STATE INTERVENTION IN SOCIAL ECONOMY.

By M. ANATOLE LEROY BEAULIEU.

THE Church has now a social doctrine which some Catholics assume to impose on the faith as a teaching of infallible authority. The papacy, turning toward the democracy, has presented a programme of social reform;* and in the face of the courtiers and of the people has declared to the age that the first article of the social reform must be a moral reform. This is a hard word to many ears, and the wise men of the world hearing it shake their heads and pass on. "Is that all you have to tell us?" the children of the age seem to say; "we have other things to do than stop to hear your wise advice. The time for these moral lessons has passed. Our progressive age wants something newer and more substantial, which it will hardly go for to Rome." Pope Leo XIII seems to have anticipated these sarcastic reflections, and his language is in marked distinction from that of his predecessors, by his not talking of religion and morals alone. He knows that this is not enough for the unbelieving masses; and after having reminded us that God alone can save us, he does not refuse to consider the means proposed by the wisdom or imagination of men for the pacification of contemporary society; and he examines these means with a kindly and patient solicitude, not as a mystic bent on exposing their vanity, but as a practical man anxious to find early solutions, and sincerely desiring to ameliorate the material position of the working classes.

Two ways to this result are open to our society: one by the intervention of the state, the other by special associations. Leo XIII has examined them both very carefully; and we purpose to see what he thinks of the first, the broadest one, on which the masses would cast themselves as if by instinct. Is the Church in favor of the intervention of the state or against it? The ma-

* In the Labor Encyclical.

jority believe that, whether we be Catholic or heterodox, we must be for one or the other; that there can be no middle ground. But as a Catholic, Albert de Mun, has remarked, nothing so quickly leads to inexactness as the passion for arranging men and doctrines in separate groups and designating them by special terms. Such a classification would be especially fallacious in this case; for I do not know of any persons who utterly reject the intervention of the state. In one sense everybody is an interventionist, for we all agree with Leo and the theologians that it is the state's duty to protect the rights of every one, and that the repression of abuses belongs to it. But where does the function of protecting individuals which devolves upon the state begin, where does it end, over what does it extend? We do not all form the same conception of the attributes of the public power. This divergence is more important to our society than the contests of republicans and monarchists or the quarrels of opportunists and radicals. This, and not fastidious controversies on forms of government or the validity of constitutions, constitutes the vital question for modern nations.

The doctrine of *laissez-faire*, or let alone, has lately enjoyed in some states an authority which it does not deserve. It was once a device of freedom, but it was a negative device, and neither science nor society can rest wholly on a negation. Those who have tried to refer all economical science to it have only succeeded in discrediting political economy and economists. The let-alone, applied where it does not belong—to the work of children and girls in the shop or the mine, for example—becomes inhuman and murderous, and, as it were, the accomplice of the criminal exploitation of misery and vice. Hence it has gone into disfavor; and, as often happens to our human weakness, which straightens itself on one side only to lean over on the other, the inevitable reaction against the famous maxim of Gournay has passed just bounds.

This phrase was applied by those who invented it to industry, commerce, and labor. In demanding the let-alone, Gournay and the economists of the eighteenth century claimed for every Frenchman the right to make, sell, buy, and carry agricultural and industrial products freely. The demand was a protest against the minute and ruinous regulations of the old *régime*, against the pretension to hold in leading-strings everything in the kingdom that lived by labor. In this sense the *laissez-faire* is eternally true. Of all the phrases pronounced in France, it was one of those which resounded the farthest—the one, perhaps, that has put French words upon the largest number of human lips. The brief maxim, of which few know the author, has made the tour of the globe, and has contributed a good share to the renovation of

the world. To it is due the emancipation of labor, and the development by that of public wealth in the nineteenth century. Because a generation or two, in two or three countries, have abused it, is no reason for forgetting its services, especially at a time when we see the old chains brought back, or new ones in forging, with which to load industry and labor.

The third part of the Pope's Encyclical is devoted to this important subject, and, after touching upon several aspects of the question, he concludes that "equity requires that the state concern itself with the workmen, and so act that, of all the goods they secure for society, a suitable part shall return to them, such as habitation and clothing, and that they may live at the cost of the fewest pains and privations. Whence it follows that the state should favor all that closely or remotely appears calculated to ameliorate their lot." Such is the Pope's theory; but this is of less importance than the practice. If the state has a right to intervene, what should be the conditions and what the limits of its intervention? The Pope is very careful in expressing himself on this point, and declares that intervention ought not to be exercised except when it is absolutely indispensable, or when there is no other means of opposing the evils with which society is afflicted, and should be limited to seeing that every individual's rights are respected and preserved. If it comes to pass, he says, that workmen, abandoning their work or suspending it by strikes, menace public tranquillity; that the natural bonds of the family are relaxed among them; that religion is violated by employers not leaving them time to perform their duties of worship; if, by promiscuous mingling of the sexes or other excitations to vice, the factories imperil morality; if the employer imposes iniquitous burdens on the workmen, or dishonors their manhood by unworthy and degrading conditions; if he endangers their health by excessive tasks, disproportionate to their sex or age—in such cases it is necessary to use, within certain limits, the force and authority of the laws. In the protection of private rights, the Pope adds, the state should concern itself especially with the weak and indigent; and he qualifies his whole expression by saying that the law should undertake nothing beyond what is necessary to repress abuses and remove dangers.

The idea of the state as a Providence appears to us not only false and pernicious from the social point of view; it seems to have about it, too, in these days, something unchristian: it has a pagan flavor, a scent of sacrilegious usurpation. We discern in it a pretension of the state to erect itself into a divinity which shall take the place of the invisible God and arrogate to itself his function on the earth. It is as if there were a revolution in the government of the universe, as if another Providence were coming in to

take the place of the old one and dethrone him. We know that the old churchmen saw something divine in the origin and nature of the state; but then there were in those days relations between the Church and the state that exist no longer. The kings and emperors of the middle ages never dreamed habitually of deifying themselves, or of attributing to themselves in their own personalities a divine mission. Even in its highest pretensions and most impudent usurpations the state of the old *régime* was never ashamed to bow before God, it acknowledged that it held its power from him, and considered itself under obligations to make his laws respected. The Church never saw an adversary or a rival in it; if it rebelled occasionally against the supremacy of the ecclesiastical power, the Church could always hope to bring it back to docility and obedience.

But we mistrust the modern state, both as Christians and as citizens. This modern state, monarchical or republican; the bureaucratic state, with a hundred arms reaching everywhere; the elective state, headless or many-headed, changing, incoherent, capricious, constantly inclined to usurp the functions of the family, of private societies, of individuals—we are afraid to extend its competence beyond bounds. We know it too well to give ourselves up to it. We know by experience how heavy and clumsy its hand is; how violent, rough, arbitrary, and tyrannical are its processes, and how presumptuous and costly are its methods. The Church itself knows something of its character and proceedings. St. Thomas of Aquinas said the state was the servant of God for good. But is it God whose minister the contemporary state is? Even when it does not sin by doctrinal presumption, or by anti-religious intolerance, or by usurpation of authority over the family, the state seems to us morally incapable of assuming the high mission which some of the sons of the Church seem to claim for it. It is inspired neither with Christian law nor with the law of God, nor with the ideal justice which such persons prescribe as its guides. Its law and rule are not justice, but electoral interests. Instead of being, as it is invited to be, an impartially serene authority, lifted above all classes and providing equitably for all, the state which we know and whose workings we witness is essentially partial. The child of government by party, it is, we might say, partial by derivation. Instead of the traditional balances of justice, it has two weights and two measures in everything. It has none of the qualities of an earthly Providence: not foresight, or intelligence, or equity, or wisdom. It is always ready to encroach upon a domain which is not its own, and in every direction; it is careless of the rights of others, and recognizes hardly any but those which it has established; it assumes to be the only law-maker, and imagines that it creates right. It believes that

everything is permitted it, and vaunts itself on subjecting everything. It wants to be all, and its will is changing, violent, and weak by turns, like the passionate majorities and the ignorant crowds whence it emanates; and so slight is our confidence in the state that its mobility reassures us more than it scares us.

Yes, we distrust the state, whatever its name or shape; we distrust its prudence, its lights, its doctrines, and its aims; its processes, its methods, its propensity to regulate, its obstructiveness, and its self-conceit; its morality, its conscience, and its probity. It worries us to see in it the organ of right and the instrument of justice. We can not arm the state with new rights or fortify its power on one side without re-enforcing it on all sides. The domain of public authority can not be extended over all interests and private contracts without enslaving the individual and subjecting the family to it. No artifice of political science can find means to make the state the master of economical life, the omnipotent arbiter of the mill and the shop, without our societies that live by work being taken wholly into its hand. There is only one way to establish forever the despotism of the state in the world, but there is one, and it is this.

Even if the modern state should become more equitable and more enlightened; if it should become really something else than an irresponsible collectivity exercising power by changing and passionate proxies; if it should put away its sectarian spirit and its tyrannical processes—we should still doubt its competence and its capacity to regulate the mill and the shop. The state is a weighty engine, with slow-running machinery uselessly complicated, which exacts a considerable expenditure of fuel and manual labor for the least work. No other instrument makes a feebler return and wastes so much force. Consequently, the more we extend the action of the state the more we risk impoverishing the country. Instead of hastening the development of national wealth, the state is calculated to hinder it by restraining the free factors of capital and labor. It is always a reproach which its intervention can not escape, and a very grave one in social and economical matters, that the meddling of public authority unnerves private initiative. This of itself would be a cause of uneasiness, for private initiative has always been the main-spring of progress; to break it or paralyze it by enveloping it with laws and regulations which would arrest or restrict its play would be to fetter the progress of industry and of wealth, and to delay the improvement of the condition of the masses. Further than this, in social questions themselves—questions belonging to the workmen—the intervention of the state, with its vexatious processes and its annoying habits, would generally simply end in depressing instead of stimulating private forces and living energies, humanitarian philanthropy and Chris-

tian charity. We have already proof of this in public benevolence, which seems, at great expense, to have sterilized the field which private benevolence had fertilized. Beware, lest, instead of inspiring patrons and capitalists, industrial societies and industrial managers, to fulfill their social duty in a larger sense, the arbitrary intervention of the state does not dissuade or discourage them from it! Symptoms of such discouragement are already beginning to appear in France. We, in fact, slander ourselves when we represent that private initiative has been sterile in this sphere. Not so; on the contrary, it is one of the domains in which our end of the century has deserved the most from France and mankind. I want no better evidence of this than the group of social economy, or, as it was justly styled, "of social peace," in our Universal Exposition of 1889, where were represented in fifteen sections: remuneration for labor and participation in benefits; co-operative associations for production; professional syndicates; apprenticeship and patronage societies; mutual aid societies; superannuation and pension funds; accident and life assurance; co-operative consumers' associations; co-operative credit associations; workmen's houses; workmen's circles and people's societies; social hygiene and temperance societies; societies for the protection of children; and national institutions. These fifteen sections of social economy prove by actual specimens that men of means are not insensible to the ills of the working classes, and that our society has not waited for the urging of the state before it occupied itself with questions of interest to working-men. The greater part of the works, foundations, associations, and social enterprises to which awards were made in 1889 were relatively recent, some of them entirely new. They have been tending for several years past to make a rapid advance. Heaven prevent the intervention of the state which is threatened, inflicting a fatal blow on all these creations of private initiative! The state has a heavy hand, not to call it a paw. It often unwittingly crushes what it touches. There is something depressing and stifling in administrative regulation; may it not for a long time yet put the brakes upon a movement from which so much is promised!—*Selected and translated for The Popular Science Monthly from the Revue des Deux Mondes.*

THE emigration of the English agricultural population into the towns is attributed by Mr. T. E. Kebbel, among other causes, to the dullness of village life. The old feasts, the fairs, and the games have for the most part disappeared. Thus, while there is vastly more cricket played in England than fifty years ago, it is not played by the same class. In the old day-long matches on the village greens, the elevens were mostly made up of laborers. They are so no longer.

HISTORICAL NOTES ON THE GOLD-CURE.*

By Prof. H. CARRINGTON BOLTON.

AVOIDING all discussion of the merits or demerits of the so-called bichloride-of-gold cure, now so prominent in the public mind, we propose to show that the use of gold as a medicine is not so novel as commonly thought; and by extracts from early writers on chemistry and medicine to indicate the opinions held with respect to alleged "tinctures of gold" at different periods during several centuries.

The precious metal has been employed both externally and internally, in the metallic state, in solution, and by sympathy, for a great variety of the ills that flesh is heir to, for over two thousand years. The train of thought which led the ancients to employ this highly prized material can be well told in the quaint language of the distinguished Dutch physician and chemist, Hermann Boerhaave; writing about 1725, he says: "The alchemists will have this metal contain I know not what radical balm of life capable of restoring health and continuing it to the longest period. What led the early physicians to imagine such wonderful virtue in gold was that they perceived certain qualities therein which they fancied must be conveyed thereby into the body; gold, for instance, is not capable of being destroyed, hence they concluded it must be very proper to preserve animal substances and save them from putrefaction; which is a method of reasoning very much like that of some fanciful physicians who sought for an assuaging remedy in the blood of an ass's ear by reason the ass is a very calm beast!" (Shaw's translation, Boerhaave's Chemistry, London, 1727.)

Something of this sympathetical and mental effect was evidently sought to be attained in the very first instance of the administration of gold recorded in history. "And Moses took the (golden) calf which they had made, and burnt it with fire, and ground it to powder, and strewed it upon the water, and made the children of Israel drink of it." (Exodus, xxxii, 20.)

Pliny, in his marvelous compilation, "Natural History," written about 70 A. D., has a paragraph on the "medicinable virtues of gold" which in "divers waies is effectual in the cure of many diseases. For first of all sovereign it is for green wounds, if it be outwardly applied." Pliny describes a form of liniment of gold "torrefied with salt and schistis" which "healeth the foule tettar that appeareth in the face," fistulas, etc. And he alludes to a preparation of gold in honey which "doth gently loose the belly if

* Read, in part, to the New York Academy of Sciences, June 6, 1892.

the navel be anointed therewith." And in conclusion Pliny quotes Marcus Varro, who "saith that gold wil cause warts to fal off." (Holland's translation, London, 1634.) Varro was a friend of Cicero, which carries back this belief in the efficacy of gold to the first century before Christ.

The Arabian physicians, who for hundreds of years possessed almost exclusive knowledge of chemistry, often record the virtues of gold as a remedial agent in disease. Geber, who lived in the eighth century, wrote: "Gold is a medicine rejoycing and conserving the Body in Youth." (Russell's translation, London, 1678, p. 76.) Avicenna is said to have also written in its praise; also Arnald de Villanova (1235–1312).

The preparation of gold in a potable, innocuous form occupied the attention of the alchemists during several centuries; they commonly called it *aurum potabile*, and ascribed to it not only remedial virtues but the power of prolonging life. The quotation from Geber shows that he shared this opinion.

To this elixir of life they gave many fanciful names: Elias Ashmole, in his Theatrum Chemicum Britannicum, says Saint Dunstan calls it the "food of angels," and others the "heavenly viaticum." Ashmole himself adds: "It is undoubtedly the true Alchochodon or giver of years, for by it man's body is preserved from corruption, being thereby enabled to live a long time without food; nay, 'tis made a question whether any man can die that uses it." (Written in 1652.)

The alchemists argued that this golden elixir is not to be made of vulgar gold, but only from philosophical gold prepared by hermetic art. Recipes for manufacturing this panacea abound in alchemical works, they are mostly very tedious, requiring endless repetitions and much faith on the part of the operator. One of the simplest methods of preparing *aurum potabile* is given by Samuel Bolton in his curious little 16mo, "Medicina magica tamen physica," published at London in 1650: "Put foliated gold into a vessel well sealed with Hermes' seal; put it into our fire till it be calcined to ashes; then sublime it into *flores*, having his *caput mortuum*, or black *terra damnata* in the bottom. Then let that which is sublimed be with the same degree of fire united to the same *caput mortuum* that it may be revived by it, as that all may be reduced into an Oyle which is called *Oleum Solis*. The dose hereof is two or three grains."

This description leaves much to the imagination, and in this respect differs little from others that we might quote. For the benefit of non-chemists we may add that few of the recipes yield a product containing gold, the metal often remaining in the part thrown away.

Roger Bacon, the Franciscan friar of the thirteenth century, to

whom so many wonderful discoveries and inventions have been ascribed, had deep faith in the virtues of potable gold. Bacon, in a communication to Pope Nicolas IV, informs his Holiness of an old man who found some yellow liquor in a golden flask, when plowing one day in Sicily. Supposing it to be dew, he drank it off, and was immediately transformed into a hale, robust, and highly accomplished youth. Having abandoned his day-laboring he was admitted to the service of the King of Sicily, and served the court eighty years.

The belief in a life-prolonging elixir, sometimes claimed of the tincture of gold and sometimes of secret preparations, prevailed for centuries. Even so great a philosopher as Descartes believed he had attained the art of living a few hundred years; this belief was shared by some of his friends, and when he died before reaching sixty years they were convinced that he had been poisoned.

The alchemist Raymond Lully a contemporary of Friar Bacon, also experienced the restorative effect of this fountain of youth, if we can credit the statement in the curious verses of Sir George Ripley, composed in 1471:

"An Oyle is drawne owte in colour of Gold,
Or lyke thereto out of our fire Red Lead,
Whych Raymond sayd when he was old,
Much more than Gold wold stand hym in stede.
For when he was for age nygh dede,
He made thereof *Aurum Potabile*
Whych hym revyvyd as men myght see."
(Compound of Alchymie.)

Oswald Croll, a German physician of the sixteenth century, wrote in 1609 in praise of gold as a medicine. I quote the English translation of his Basilica chymica, published at London in 1670:

"It is the principle part of a Physician that would Cure the Sick, first to comfort the Heart, and afterwards assault the Disease. Those to whom the harmonious Analogy of Superiours and Inferiours hath been known, and who from Suffrages of Astrologers have learned that to the two greatest Lights of Heaven, the two principle parts of Man, viz: the Heart and Brain, in things of Nature latently rests in *Gold*. . . . For Nature hath endowed Gold with no contemptible virtues, which who so knows how to draw out, and by ingenious Artifice is able rightly to use, he will find Gold, which seemed dead and barren, so lively and pregnant that it germinates and of itself progenerates new Gold. . . . Whence the true Philosophers have exquisitely prepared a wonderful and greatly to be desired Medicine with which the impurities of imperfect metals are removed and all vices of affects in uncurable Diseases of Humane Bodies perfectly exterminated."

Croll then says he has tried almost one hundred different preparations of *aurum potabile*, and condemns most of them to recommend his own, fulminating gold, called by him "Calx of Sol." His process embraces nauseous ingredients, and the product is, as usual, free from gold.

Paracelsus, the physician who did so much to improve materia medica by introducing chemical medicines, does not neglect gold. Thurneisser, his disciple (both as respects his teachings and his charlatanism), made his royal dupes pay enormous sums for the "tincture of gold" which entered into his extraordinary prescriptions. To the use of royal touch pieces (gold coins) in the reigns of Charles II, James II, and Queen Anne, mere allusion should be made. Christopher Glaser (1663) gives among other preparations a "diaphoretic powder of gold" and prescribes it for continuous or intermittent fevers, the dose being four to twelve grains in wine, or in a spoonful of bouillon. (Traité de la chymie, Paris, 1663.)

Antoine Lecoq (or Gallus), a physician of Paris (1540), seems to have been the first to recommend gold for syphilis. He and his follower Fallopius (of Modena, 1565) described tedious processes for making preparations of gold. These processes were carefully repeated, about the beginning of this century, by Chevallier, a French pharmacist, who declares the products contain no gold at all.

Lamotte's "gold-drops," celebrated throughout Europe for over half a century (1725 to 1780), consisted of a solution of ferric chloride in alcohol; this possessed a yellow color, and was universally regarded as a tincture of gold, until the secret was bought and made public by the Russian Government. (Kopp's Geschichte.)

Frederic Hoffman, a famous German physician (1733), recommends gold for rheumatic fever.

Johann Rudolph Glauber, the German physician whose name is indelibly attached to "Glauber's salts," thought to improve the latter by adding gold. "In all diseases and infirmities, of what name soever, the Spirit or Oil of Salt in which gold is rightly dissolved (or the *Aurum Potabile* with it), giveth present help, and in all dejections of the vital spirit . . . it giveth such relief that life and vigor may be somewhat farther protracted if two, three or four drops be administered as occasion shall serve in good Aqua vitæ or Cordiall Water. In like manner if three drops be administered once a week in generous wine or aqua vitæ, or other fit vehicle, it renovateth a man, makes him youthful, changeth gray hairs, produceth new nails and skin, preserveth from various and divers symptoms of diseases, and preserveth the body in such a state even to the prefixed hour of the Divine appointment."

This is quoted by Glauber from Conrad Khunrath in his Medulla destillatoria, and he adds: "I some time since administered this Oil of gold for eight or ten days successively to an Infant for the freeing his body from mercury." (Glauber's Works, Packe's translation, London, 1689.)

Robert Boyle, in his Usefulness of Natural Experimental Philosophy (1663), expresses doubts as to the "strange excellency" of *aurum potabile*, remarking that "learned physicians and chymists have pronounced the preparation of potable gold as itself unfeasible." And he adds: "I should much doubt whether such a potable gold would have the prodigious virtues its encomiasts ascribe to it and expect from it; for I finde not that those I have yet met with deliver these strange things upon particular experiments duly made, but partly upon the authority of chymicall books, many of which were never written by those whose names they bear." He then proceeds to blame physicians for using expensive medicines and says: "T'were a good work to substitute cheap ones for the poorer sort of patients."

The change of opinion as respects the therapeutic value of gold, foreshadowed in the quotation from the astute Boyle, is well shown by comparing the passages on the subject in two different editions of Lémery's Cours de Chymie, one published in 1680 and one in 1730. In the earlier edition of Lémery's very successful work we read: "Gold is a good remedy for those that have taken too much mercury, for these two metals do easily unite together, and by this union or amalgamation the mercury fixes and its motion is interrupted." (Page 25.) "*Aurum fulminans* causes sweat and drives out ill humors by transpiration. It may be given in the small pox two to six grains in a lozenge or electuary. It stops vomiting and is also good to moderate the active motion of mercury." (Harris's translation, London, 1680, page 9.)

And in the later edition, the eleventh of the series, Lémery or his editor makes a very different statement:

"Potable gold, so much praised by the alchemists, and sold so dear by them, is commonly only a vegetable or mineral tincture of a color resembling gold, and as they make this tincture with a spirituous menstruum, it sometimes excites perspiration. This effect they ascribe to the gold, although the metal has rarely anything to do with it." (1730.)

In the works of Caspar Neumann a passage occurs that expresses so clearly the present views of many that it is hard to realize it was written nearly one hundred and fifty years ago. Neumann writes:

"Gold has been imagined to be possessed of extraordinary medicinal virtues, and many preparations, dignified with the name of this precious metal, have been imposed upon the public;

but the virtues ascribed to gold have apparently no other foundation than credulity and superstition, and most of the golden medicines have no gold in them. Even when gold has been employed in the preparation there is seldom any of it retained in the product.

"We may say with Ludovici, 'It is better to make gold out of medicines than medicines out of gold.'" (Lewis's translation, London, 1759, page 38.)

FAMILIES AND DWELLINGS.

VII.—LESSONS FROM THE CENSUS.

By CARROLL D. WRIGHT, A. M.,
UNITED STATES COMMISSIONER OF LABOR.

THE statistics of families and dwellings, as shown by a census, offer opportunities for the study of social conditions in some very important directions. The ratio of dwellings to families, the number of persons to a dwelling, and the average size of families are all facts of the highest importance in considering the condition of the people. Such statistics also answer the question whether families are holding their own as to size, and allied with modern facts relative to the number of children born and living they enable one to determine the composition of the population and whether its various elements are being preserved with reasonable integrity.

The following short table shows the total number of families and persons to a family, by geographical divisions, in the United States, June 1, 1890:

Total Families and Persons to a Family, by Geographical Divisions.

Geographical Divisions.	Number of Families.					Persons to a Family.				
	1890.	1880.	1870.	1860.	1850.	1890.	1880.	1870.	1860.	1850.
North Atlantic.....	3,712,242	3,023,741	2,497,494	2,048,315	1,582,978	4·69	4·80	4·92	5·17	5·45
South Atlantic.....	1,687,767	1,463,361	1,132,621	652,396	537,857	5·25	5·19	5·17	5·40	5·61
North Central.....	4,598,605	3,389,017	2,480,311	1,683,190	934,873	4·86	5·12	5·23	5·34	5·69
South Central.....	2,071,120	1,697,550	1,242,411	684,024	499,767	5·30	5·25	5·18	5·51	5·70
Western.....	620,418	372,247	226,526	143,009	42,765	4·88	4·75	4·87	4·33	4·18
The United States	12,690,152	9,945,916	7,579,363	5,210,934	3,598,240	4·94	5·04	5·09	5·28	5·55

The number of families increased, from 1880 to 1890, 27·59 per cent; from 1870 to 1880, 21·22 per cent; from 1860 to 1870, 45·45 per cent; and from 1850 to 1860, 44·82 per cent.

The question is often asked, when the total number of families and the size of families under censuses are considered, what the word "family" really means. For census purposes the word "family" comprehends not only the real, normal family, as it is

commonly understood—that is, consisting of the husband, wife, children, and immediate dependents like relatives and servants—but it comprehends all persons living alone where they maintain their own establishments, and all larger aggregations of people subject to one common supervision, such as the inmates of hotels, hospitals, prisons, asylums, etc. So in nearly all Federal and State censuses in this country and all censuses abroad the family has comprehended hotels, boarding-houses, lodging-houses, penal and reformatory institutions, and every aggregation of individuals living under one roof, or has related in some way, either arbitrarily or otherwise, to one head. The inmates of a great hotel, or a great college, or a prison constitute, for census purposes, a family. It would seem at first thought that this artificial extension of the composition of the family would have a disturbing influence upon the average size of the family, but a careful analysis of results indicates that such influence is very slight. In the census of Massachusetts for 1885, the census family in its average size consisted of 4·58 persons. The Massachusetts State census offered facilities for ascertaining just the effect of considering institutions and other bodies as families upon the normal family. Eliminating all families coming under the artificial designation, it was found that the average size of the actual normal family of Massachusetts in 1885 was 4·45. The influence, therefore, arising from the inclusion of the artificial or arbitrary family, so far as that State taken as a whole was concerned, was but ·13 per cent—that is, the difference between 4·58, the average for all families of all sizes, and 4·45, the average of the normal family alone. Practically, it makes but little difference, then, so far as great bodies of people are concerned—as, for instance, the population of a State—whether the families are considered on the basis of the actual normal family or on the ordinary census basis, which includes all aggregations living under one roof or having certain relations to one head. It would not do, however, to consider this as a rule in small aggregations of people. As an illustration, Danvers, in the State of Massachusetts, contains a large asylum for the insane. The number of families in 1885, including the asylum, was 1,474, representing a population of 7,061. The average size of families on this census basis for the town of Danvers in the year named was 4·79; but, eliminating the asylum as a family, the average size of the families was 4·17, too large a variation for accurate calculations. Again, in the town of Concord, in the State named, containing the reformatory prison, the average size of the family, including the reformatory, was 5.15; excluding it, it was 4·62. Taking a college town, Wellesley, the average size of the normal family was 5·10; but, including Wellesley College, it was 6·15, or an

increase of more than one person. The rule, therefore, that the average size of the family is not materially affected by including the artificial or arbitrary family does not well apply to towns and cities in which large institutions are located. For the United States the statements given by the census, which includes all arbitrary families, may fairly be taken as representing the average family.

The decrease in the size of families is a subject which causes some alarm. Taking the United States as a whole, it is found by the census figures that in 1850 the average family consisted of 5·55 persons. There has been a gradual decrease, it being in 1860 5·28, in 1870 5·09, in 1880 5·04, and in 1890 4·94. Looking at the different geographical divisions, it is found that this rule holds true except in the Western division, where the average size of the family has risen from 4·18 in 1850 to 4·88 in 1890, the increase having been steady through the intermediate decades. This result would have been expected, of course, on account of the settlement of the West in the last few years, the population having increased rapidly and being more and more brought to the family basis instead of that of single individuals or young families settling in Western Territories. The small average size of the family in Oklahoma, now a Territory just opened for settlement, shows the influence of new settlements upon the size of the family. In Oklahoma the size of the family will increase until population becomes fairly dense, when it will follow the rule of older communities and decrease. When population becomes more or less urban in character the maximum is reached, and after that a constantly receding average will probably be shown at each succeeding census. A study of one hundred of the principal cities of the country having a population of 25,000 or more, and on the basis of 1880 and 1890, shows with but few exceptions a decrease in the average size of the family. The exceptions are chiefly in the South and West, as might be expected, and as is found regarding those two sections generally. In New York city the average size of the family has decreased from 4·96 in 1880 to 4·84 in 1890, while in Chicago the decrease has been from 5·19 to 4·99 during the same period.

It would be very gratifying if the Federal census statements as to size of families and other social features of population could be carefully verified by independent enumerations. This possibility exists in some cases where States take an independent census. I will call attention to one only, and that the State of Massachusetts, with whose statistics I am more or less familiar. The United States census just taken gives the average size of family in Massachusetts in 1870 as 4·77. The State census of 1875 gives the average size as 4·60. In 1880 the Federal census shows

an average size of family of 4·70, and in 1890 of 4·67. The State census for 1885 gives the average size of family as 4·58. In each case the size of family as shown by the Federal census is slightly larger than that shown by the State census. It would be quite impossible to quarrel with the Federal census so far as this single comparison is concerned.

In the eleventh census a question entirely novel in Federal censuses was asked on the population schedule. This question was as follows: "Mother of how many children, and number of these children living?" This inquiry was made concerning all women who are or have been married, including those widowed or divorced. The results of this inquiry will be of the very greatest importance. It was asked in the State census of Massachusetts for 1885. The question relates to the fecundity of women, and if the tabulations are proper will give this for different nationalities. The question involves the comparative growth of the native and foreign-born population, and is a subject of very vital importance. In the Massachusetts census for 1875 a beginning was made in the direction of securing information on this point, but to a limited extent only. In that census an inquiry was made relating simply to the number of children born to each mother; but in 1885, in the State referred to, the inquiry was extended to the form just quoted. The statistics presented in the State census for 1885 confirmed the information secured in 1875 as to the relative fecundity of women, and also supplied data in the nature of vital statistics bearing directly upon the question often raised as to whether it is better to have small families, well reared, as opposed to large families of children not always brought up under the best and most healthful conditions. The figures gathered in the State of Massachusetts showed that foreign-born mothers were more prolific than native-born mothers, while at the second inquiry it was shown that the number of children of foreign-born mothers decreased relative to the time they had lived in this country; and the general results, considered on broad grounds, indicated that the mothers having purely native parentage have relatively a slightly greater proportion of their children living than the mothers having purely foreign parentage.

The effect of dense population upon the decreasing size of the family is suggested by these crude results; but, after the Federal and State censuses shall have repeated the inquiry quoted, we may be able to determine with reasonable accuracy the exact facts relative to the decrease of families. The first results under the Federal census will be chiefly valuable because from them comparisons in future censuses can be made, and from them also can be shown whether more children are brought to mature age when members of small families than when members of large

families. This is an exceedingly vital question, and much light will be thrown upon it under future statistical investigations.

In discussing the number of families and the composition thereof, it is interesting always to learn the relation of persons to dwellings. The following table gives the total number of dwellings and persons to a dwelling, by geographical divisions, under the census of 1890:

Total Dwellings and Persons to a Dwelling, by Geographical Divisions.

Geographical Divisions.	Number of Dwellings.					Persons to a Dwelling.				
	1890.	1880.	1870.	1860.	1850.	1890.	1880.	1870.	1860.	1850.
North Atlantic.....	2,962,345	2,490,182	2,103,500	1,808,435	1,390,005	5·87	5·97	5·85	5·86	6·21
South Atlantic.....	1,626,372	1,383,403	1,102,778	656,074	528,590	5·45	5·49	5·31	5·37	5·71
North Central.....	4,287,486	3,172,734	2,405,620	1,688,446	911,565	5·22	5·47	5·40	5·32	5·83
South Central.....	2,007,279	1,023,664	1,197,569	668,387	490,280	5·47	5·49	5·37	5·64	5·81
Western.....	599,836	345,739	233,350	148,350	41,891	5·05	5·11	4·24	4·17	4·27
The United States	11,483,318	8,955,812	7,042,833	4,969,692	3,362,337	5·45	5·60	5·47	5·53	5·94

An examination of the foregoing table proves that the number of persons to a dwelling is constantly decreasing, although slightly, thus indicating increased comfort on the part of the population as a whole. In 1850 there were 5·94 persons to each dwelling in the country, while in 1890 the average was 5·45. In the West, however, this statement is reversed, for in 1850 the number of persons to a dwelling was 4·27, and in 1890 it had increased to 5·05. This, as in the case of the increased size of family, shows the effects of the new settlements.

A dwelling, for census purposes, means any building or place of abode in which any person was living at the time the census was taken, whether the abode was a room above a warehouse or factory, a loft above a stable, a wigwam on the outskirts of a settlement, a hotel, a boarding or lodging house, a large tenement-house, or the dwelling-house ordinarily considered as such. On this basis the number of dwellings in 1890 had increased 28·22 per cent over the number in 1880. In 1890 there were 11,483,318 dwellings and 12,690,152 families, there thus being 10·51 per cent more families than dwellings, while in 1880 the excess was 11·06 per cent, and in 1850 it was 7·02 per cent.

It should be remembered, in making any comparison between dwellings and persons from 1850 to 1890, that in 1860 and 1870 the total number of dwellings included both occupied and unoccupied dwellings, while in 1850, 1880, and 1890 the total number of occupied dwellings only was reported. Again, in 1850 and 1860 the number of dwellings stated was for the free population only, the dwellings of the slave population in those censuses not being returned. Any figures, therefore, for 1850 to 1870, inclusive, do not afford a very fair basis of comparison. The table just given should be used in the light of these remarks.

The excess of families over dwellings in 1890, 1880, and 1850, both as regards number and per cent, is shown in the following brief table:

Excess of Families over Dwellings.

Geographical Divisions.	1890.		1880.		1850.	
	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.
North Atlantic	749,897	25·31	598,559	24·42	192,973	13·88
South Atlantic	61,395	3·77	79,808	5·77	9,261	1·75
North Central	311,119	7·26	216,283	6·82	23,208	2·56
South Central	63,841	3·18	73,886	4·55	9,487	1·94
Western	20,582	3·43	26,508	7·07	874	2·09
The United States	1,206,834	10·51	990,104	11·06	235,903	7·02

The statistics of dwellings and families already published show the classification by the number of persons and dwellings for the different States and by the United States as a whole. The following brief summary, however, by geographical divisions, is all that space will permit. This table shows the total number of persons to a dwelling, from 1 person to 11 and over:

Persons to a Dwelling, by Geographical Divisions.

Geographical Divisions.	1 person.	2 persons.	3 persons.	4 persons.	5 persons.	6 persons.
North Atlantic	71,997	342,778	458,510	477,256	432,942	337,780
South Atlantic	51,364	166,833	223,395	238,170	236,164	200,911
North Central	130,596	484,266	669,220	723,592	667,602	526,595
South Central	55,661	203,005	273,430	294,503	294,308	249,892
Western	60,449	79,854	87,343	88,569	81,449	60,865
The United States	370,067	1,276,736	1,711,898	1,822,092	1,712,525	1,375,953

Geographical Divisions.	7 persons.	8 persons.	9 persons.	10 persons.	11 persons and over.
North Atlantic	249,985	175,762	118,176	87,393	209,764
South Atlantic	166,054	127,770	89,290	70,398	56,028
North Central	386,706	266,911	169,576	115,906	146,576
South Central	208,350	160,019	112,402	90,315	65,364
Western	45,194	32,106	21,625	21,142	21,240
The United States	1,056,289	762,568	511,069	385,149	498,972

The facts in the foregoing table, reduced to percentages and to a classification somewhat briefer than the foregoing summaries, give the following results:

Geographical Divisions.	Persons to a dwelling.							
	1 person.		2 to 6 persons.		7 to 10 persons.		11 persons and over.	
	Per cent of dwellings.	Per cent of population.	Per cent of dwellings.	Per cent of population.	Per cent of dwellings.	Per cent of population.	Per cent of dwellings.	Per cent of population.
North Atlantic	2·43	0·41	69·18	46·91	21·31	29·27	7·08	23·41
South Atlantic	3·16	0·58	65·51	49·08	27·89	41·68	3·44	8·71
North Central	3·05	0·58	71·63	55·31	21·90	33·66	3·42	10·45
South Central	2·77	0·51	65·52	48·99	28·45	42·40	3·26	8·10
Western	10·08	2·00	66·37	51·14	20·01	32·34	3·54	14·52
The United States	3·22	0·59	68·79	50·78	23·64	35·04	4·35	13·59

From this table it is understood that the number of dwellings having 1 person only represents 3·22 per cent of the whole number of dwellings in the United States, while the population of such dwellings is but ·59 per cent of the total population. Dwellings containing from 2 to 6 persons represent over two thirds of all the dwellings, and about one half of the whole population. About 4·33 per cent of the dwellings contain more than 10 persons, and represent 13·59 per cent of the total population. Examining the results in this direction for twenty-eight cities, or those having a population of 100,000 and over, the Census Office presents the following tabular statement:

Cities.	PERSONS TO A DWELLING.							
	1 person.		2 to 6 persons.		7 to 10 persons.		11 persons and over.	
	Per cent of dwellings.	Per cent of population.	Per cent of dwellings.	Per cent of population.	Per cent of dwellings.	Per cent of population.	Per cent of dwellings.	Per cent of population.
New York, N. Y.	1·29	0·07	26·45	6·27	22·44	10·16	49·82	83·50
Chicago, Ill.	1·00	0·12	45·54	22·85	28·92	27·85	24·54	49·18
Philadelphia, Pa.	1·15	0·20	69·94	51·75	24·52	35·26	4·39	12·79
Brooklyn, N. Y.	0·97	0·10	39·30	17·83	30·08	25·42	29·65	56·65
St. Louis, Mo.	2·46	0·33	49·77	28·54	31·31	34·87	16·46	36·26
Boston, Mass.	1·19	0·14	44·18	22·35	30·40	29·71	24·23	47·80
Baltimore, Md.	1·09	0·18	62·22	44·31	30·80	41·37	5·89	14·14
San Francisco, Cal.	3·65	0·58	64·43	41·18	24·88	32·07	7·04	26·17
Cincinnati, Ohio	1·32	0·15	45·75	22·23	28·03	26·10	24·90	51·52
Cleveland, Ohio	1·29	0·21	65·38	46·02	26·80	36·35	6·53	17·42
Buffalo, N. Y.	1·23	0·18	57·31	35·42	28·76	34·38	12·70	30·02
New Orleans, La.	3·16	0·56	65·81	47·08	25·81	37·42	5·22	14·94
Pittsburg, Pa.	1·30	0·20	59·41	40·02	30·88	39·72	8·46	20·06
Washington, D. C.	1·96	0·33	64·13	45·38	28·36	38·74	5·55	15·55
Detroit, Mich.	1·31	0·23	69·44	51·44	24·19	34·86	5·06	13·47
Milwaukee, Wis.	1·56	0·25	60·54	41·12	29·16	38·04	8·74	20·59
Newark, N. J.	0·94	0·12	48·67	27·29	30·90	32·58	19·49	40·01
Minneapolis, Minn.	4·07	0·63	57·37	37·55	28·00	34·96	10·56	26·86
Jersey City, N. J.	1·02	0·12	47·50	23·63	28·71	26·84	22·77	49·41
Louisville, Ky.	1·80	0·28	58·64	38·44	29·58	37·54	9·98	23·74
Omaha, Neb.	1·29	0·19	59·16	36·27	31·32	37·95	8·23	25·59
Rochester, N. Y.	1·52	0·27	69·66	51·27	24·15	34·86	4·67	13·60
St. Paul, Minn.	3·69	0·58	59·20	39·62	27·94	35·73	9·17	24·07
Kansas City, Mo.	3·43	0·60	66·59	46·79	23·89	34·01	6·09	18·60
Providence, R. I.	1·71	0·23	48·32	27·43	31·38	34·58	18·59	37·76
Denver, Col.	2·87	0·48	68·31	46·28	22·74	31·53	6·08	21·71
Indianapolis, Ind.	2·13	0·43	77·54	61·16	17·71	28·34	2·62	10·07
Allegheny, Pa.	1·00	0·16	59·23	40·12	31·36	40·15	8·41	19·57

From this table we find that there were in New York city at the time of the last Federal census a total of 81,828 occupied dwellings. More than 50 per cent of these contain from 1 to 10 persons, and a little less than 50 per cent contain more than 10 persons. The population represented by dwellings in New York city having 10 persons or less is 250,002, or 16·50 per cent of the whole population, while the population represented by dwellings having more than 10 occupants is 1,265,299, or 83·50 per cent of the entire population.

The population of Chicago is about evenly divided between the two classes of dwellings, 50·82 per cent living in dwellings having from 1 to 10 occupants, and 49·18 per cent living in dwellings containing more than 10 persons each on the average.

In Philadelphia a very different condition of affairs is seen.

Out of a total of 187,052 dwellings, which is more than twice the number of dwellings in New York city and about 50 per cent more than in Chicago, 178,839, or 95·61 per cent, of the dwellings contain 10 persons or less, and only 8,213 dwellings, or 4·39 per cent of the whole, contain more than 10 persons. Relative to population, 913,076 out of a total of 1,046,964 people in Philadelphia live in dwellings containing 10 persons or less, and this is 87·21 per cent of the total population, while only 12·79 per cent of the total population, or, in round numbers, 133,888, live in dwellings having more than 10 occupants.

This is so important a subject, and one which the public desires so much to study, that I repeat one of the tables given in the recent census bulletin on dwellings and families. This table is for the twelve cities stated in the preceding one, and it shows the figures concerning persons in dwellings having more than 10 occupants, the per cent of dwellings having from 1 to 10 persons, from 11 to 15 persons, from 16 to 20 persons, and 21 persons and over, each, together with the population by number and per cent contained in such dwellings:

Cities.	Total dwellings.	DWELLINGS WITH				Total population.	POPULATION OF DWELLINGS WITH			
		1 to 10 persons.	11 to 15 persons.	16 to 20 persons.	21 persons and over.		1 to 10 persons.	11 to 15 persons.	16 to 20 persons.	21 persons and over.
NUMBER.										
New York	81,828	41,059	10,884	6,789	23,596	1,515,301	250,002	133,018	121,495	1,010,786
Chicago	127,871	96,493	17,760	7,509	6,109	1,099,850	558,927	225,123	132,925	182,875
Philadelphia	187,052	178,839	6,403	1,135	675	1,046,964	913,076	78,228	20,000	35,660
Brooklyn	82,282	57,882	12,055	5,465	6,880	806,343	349,532	152,631	96,930	207,250
St. Louis	60,937	50,907	6,668	1,987	1,375	451,770	287,983	82,976	34,999	45,812
Boston	52,669	39,908	8,082	2,818	1,861	448,477	234,123	102,332	49,540	62,482
Baltimore	73,112	67,867	3,603	384	258	434,439	373,031	43,585	6,727	11,096
Cincinnati	33,487	25,149	4,189	1,976	2,173	296,908	143,947	52,532	35,043	65,086
Buffalo	37,290	32,556	3,237	894	603	255,664	178,919	40,339	15,729	20,677
Newark	23,296	18,755	2,962	959	620	181,830	109,085	37,948	16,857	18,640
Jersey City	18,562	14,336	2,011	944	1,271	163,003	82,467	25,428	16,757	38,351
Providence	17,629	14,360	2,267	672	340	132,146	82,255	28,943	11,756	9,192
PER CENT.										
New York	.....	50·18	12·69	8·30	28·83	.....	16·50	8·78	8·02	66·70
Chicago	.....	75·46	13·89	5·87	4·78	.....	50·82	20·47	12·08	16·63
Philadelphia	.....	95·61	3·42	0·61	0.36	.....	87·21	7·47	1·91	3·41
Brooklyn	.....	70·35	14·65	6·64	8·36	.....	43·35	18·93	12·02	25·70
St. Louis	.....	83·54	10·94	3·26	2·26	.....	63·74	18·37	7·75	10·14
Boston	.....	75·77	15·35	5·35	3·53	.....	52·20	22·82	11·05	13·93
Baltimore	.....	94·11	5·00	0·53	0·36	.....	85·87	10·03	1·55	2·55
Cincinnati	.....	75·10	12·51	5·90	6·49	.....	48·48	17.80	11·80	21·92
Buffalo	.....	87·30	8·68	2·40	1·62	.....	69·98	15·78	6·15	8·09
Newark	.....	80·51	12·71	4·12	2·66	.....	59·99	20·49	9·27	10·25
Jersey City	.....	77·23	10·83	5·09	6·85	.....	50·59	15·60	10·28	23·53
Providence	.....	81·41	12·85	3·81	1·93	.....	62·24	21·37	8·90	7·49

"From this table it is seen that in New York city 23,596 dwellings, or 28.83 per cent of all the dwellings, have more than 20 persons to each dwelling, and contain in the aggregate 1,010,786 persons, or 66·70 per cent of its total population. Of this number of dwellings it has been found, by a special tally for New York city, that 8,313 contain from 21 to 30 persons, 9,350 from 31 to 50 persons, 5,460 from 51 to 100 persons, and 473 over 100 persons. In Brooklyn 25·70 per cent, in Jersey City 23·53 per cent, and in Cin-

cinnati 21·92 per cent of their total population live in dwellings containing more than 20 persons. The per cent of population in Chicago living in dwellings with more than 20 persons to a dwelling is 16·63 per cent, in St. Louis 10·14 per cent, in Boston 13·93 per cent, in Buffalo 8·09 per cent, in Newark 10·25 per cent, and in Providence 7·49 per cent. In Philadelphia only 3·41 per cent and in Baltimore but 2·55 per cent of the population are contained in dwellings with more than 20 persons."

VERACITY.*

By HERBERT SPENCER.

COMPLETE truthfulness is one of the rarest of virtues. Even those who regard themselves as absolutely truthful are daily guilty of over-statements and under-statements. Exaggeration is almost universal. The perpetual use of the word "very," where the occasion does not call for it, shows how widely diffused and confirmed is the habit of misrepresentation. And this habit sometimes goes along with the loudest denunciations of falsehood. After much vehement talk about "the veracities," will come utterly unveracious accounts of things and people—accounts made unveracious by the use of emphatic words where ordinary words alone are warranted: pictures of which the outlines are correct but the lights and shades and colors are doubly and trebly as strong as they should be.

Here, among the countless deviations of statement from fact, we are concerned only with those in which form is wrong as well as color—those in which the statement is not merely a perversion of the fact but, practically, an inversion of it. Chiefly, too, we have to deal with cases in which personal interests of one or other kind are the prompters to falsehood:—now the desire to inflict injury, as by false witness; now the desire to gain a material advantage; now the desire to escape a punishment or other threatened evil; now the desire to get favor by saying that which pleases. For in mankind at large, the love of truth for truth's sake, irrespective of ends, is but little exemplified.

Here let us contemplate some of the illustrations of veracity and unveracity—chiefly unveracity—furnished by various human races.

The members of wild tribes in different parts of the world, who, as hunters or as nomads, are more or less hostile to their neigh-

* From The Principles of Ethics, vol. i, by Herbert Spencer. New York: D. Appleton & Co., 1892.

bors, are nearly always reprobated by travelers for their untruthfulness; as are also the members of larger societies consolidated by conquest under despotic rulers.

Says Burton of the Dakotas—"The Indian, like other savages, never tells the truth." Of the Mishmis, Griffith writes—"They have so little regard for truth, that one can not rely much on what they say." And a general remark, *à propos* of the Kirghiz, is to the same effect. "Truth, throughout Central Asia, is subservient to the powerful, and the ruler who governs leniently commands but little respect."

Of the settled societies, the first to be named is the Fijian. Williams tells us that—

> "Among the Fijians the propensity to lie is so strong, that they seem to have no wish to deny its existence. . . . Adroitness in lying is attained by the constant use made of it to conceal the schemes and plots of the Chiefs, to whom a ready and clever liar is a valuable acquisition. . . . 'A Fijian truth' has been regarded as a synonym for a lie."

Of kindred nature, under kindred conditions, is the trait displayed by the people of Uganda.

> "In common with all savage tribes, truth is held in very low estimation, and it is never considered wrong to tell lies; indeed, a successful liar is considered a smart, clever fellow, and rather admired."

So, too, was it among the ancient semi-civilized peoples of Central America. De Laet says of certain of them, living under a despotic and bloody regime—"they are liars, like most of the Indians." And concerning the modern Indians, who may be supposed to have preserved more or less the character of their progenitors, Dunlop writes:—

> "I never have found any native of Central America, who would admit that there could be any vice in lying; and when one has succeeded in cheating another, however gross and infamous the fraud may be, the natives will only remark, '*Que hombre vivo*' (What a clever fellow)."

A like fact is given by Mr. Foreman in his work on the Philippine Islands. He says the natives do not "appear to regard lying as a sin, but rather as a legitimate, though cunning, convenience."

The literatures of ancient semi-civilized peoples yield evidence of stages during which truth was little esteemed, or rather, during which lying was tacitly or openly applauded. As we saw in a recent chapter (§ 127) deception, joined with atrocity, was occasionally inculcated in the early Indian literature as a means to personal advancement. We have proof in the Bible that, apart from the lying which constituted false witness, and was to the injury of a neighbor, there was among the Hebrews but little reprobation of lying. Indeed it would be remarkable were it otherwise,

considering that Jahveh set the example; as when, to ruin Ahab, he commissioned "a lying spirit" (1 Kings, xxii, 22) to deceive his prophets; or as when, according to Ezekiel, xiv, 9, he threatened to use deception as a means of vengeance.

"If the prophet be deceived when he hath spoken a thing, I the Lord have deceived that prophet, and I will stretch out my hand upon him, and will destroy him from the midst of my people Israel."

Evidently from a race-character which evolved such a conception of a deity's principles, there naturally came no great regard for veracity. This we see in sundry cases; as when Isaac said Rebecca was not his wife but his sister, and nevertheless received the same year a bountiful harvest: "the Lord blessed him" (Genesis, xxvi, 12); or as when Rebecca induced Jacob to tell a lie to his father and defraud Esau—a lie not condemned but shortly followed by a divine promise of prosperity; or as when Jeremiah tells a falsehood at the king's suggestion. Nor do we find the standard much changed in the days of Christ and after: instance the case of Paul, who, apparently rather piquing himself on his "craft and guile," elsewhere defends his acts by contending that "the truth of God hath more abounded through my lie unto his glory." (Romans, iii, 7.)

Much regard for veracity was hardly to be expected among the Greeks. In the *Iliad* the gods are represented not only as deceiving men but as deceiving one another. The chiefs "do not hesitate at all manner of lying." Pallas Athene is described as loving Ulysses because he is so deceitful; and, in the words of Mahaffy, the Homeric society is full of guile and falsehood."* Nor was it widely otherwise in later days. The trait alleged of the Cretans—"always liars"—though it may have been more marked in them than in Greeks at large, did not constitute an essential difference. Mahaffy describes Greek conduct in the Attic age as characterized by "treachery" and "selfish knavery,"

* Marvelous are the effects of educational bias. Familiarity with the doings of these people, guilty of so many "atrocities," characterized by such "revolting cruelty of manners," as Grote says, who were liars through all grades from their gods down to their slaves, and whose religion was made up of gross and brutal superstitions, distinguishes one of our leading statesmen; and, joined to familiarity with the doings of other Greeks, is thought by him to furnish the best possible preparation for life of the highest kind. In a speech at Eton, reported in *The Times*, of 16 March, 1891, Mr. Gladstone said—"If the purpose of education is to fit the human mind for the efficient performance of the greatest functions, the ancient culture, and, above all, Greek culture, is by far the best, the most lasting, and the most elastic instrument that can possibly be applied to it." Other questions aside, one might ask with puzzled curiosity which of Mr. Gladstone's creeds, as a statesman, it is which we must ascribe to the influence of Greek culture—whether the creed with which he set out as a Tory when fresh from Oxford, or the extreme radical creed which he has adopted of late years?

and says that Darius thought a Greek who kept his word a notable exception.

Evidence of the relation between chronic hostilities and utter disregard of truth, is furnished throughout the history of Europe. In the Merovingian period—"the era of blood"—oaths taken by rulers, even with their hands on the altar, were forthwith broken; and Salvian writes—"If a Frank forswear himself, where's the wonder, when he thinks perjury but a form of speech, not of crime?" After perpetual wars during the two hundred years of the Carolingian period, with Arabs, Saracens, Aquitanians, Saxons, Lombards, Slavs, Avars, Normans, came the early feudal period, of which H. Martin says:—

"The tenth [century] may pass for the era of fraud and deceit. At no other epoch of our history does the moral sense appear to have been so completely effaced from the human soul as in that first period of feudalism."

And then, as an accompaniment and consequence of the internal conflicts which ended in the establishment of the French monarchy, there was a still-continued treachery: the aristocracy in their relations with one another "were without truth, loyalty, or disinterestedness. . . . Neither life nor character was safe in their hands." Though Mr. Lecky ascribes the mediæval "indifference to truth" to other causes than chronic militancy, yet he furnishes a sentence which indirectly yields support to the induction here made, and is the more to be valued because it is not intended to yield such support. He remarks that "where the industrial spirit has not penetrated, truthfulness rarely occupies in the popular mind the same prominent position in the catalogue of virtues" as it does among those "educated in the habits of industrial life."

Nor do we fail to see at the present time, in the contrasts between the Eastern and Western nations of Europe, a like relation of phenomena.

Reflection shows, however, that this relation is not a direct one. There is no immediate connection between bloodthirstiness and the telling of lies. Nor because a man is kind-hearted does it follow that he is truthful. If, as above implied, a life of amity is conducive to veracity, while a life of enmity fosters unveracity, the dependencies must be indirect. After glancing at some further facts, we shall understand better in what ways these traits of life and character are usually associated.

In respect of veracity, as in respect of other virtues, I have again to instance various aboriginal peoples who have been thrust by invading races into undesirable habitats; and have there been left either in absolute tranquillity or free from chronic hostilities

with their neighbors. Saying of the Kois that they all seem to suffer from chronic fever (which sufficiently shows why they are left unmolested in their malarious wilds) Morris tells us that—

"They are noted for truthfulness, and are quite an example in this respect to the civilized and more cultivated inhabitants of the plains."

According to Shortt, in his *Hill Ranges of Southern India*—

"A pleasing feature in their [Sowrahs] character is their complete truthfulness. They do not know how to tell a lie. They are not sufficiently civilized to be able to invent."

I may remark in passing that I have heard other Anglo-Indians assign lack of intelligence as the cause of this good trait—a not very respectable endeavor to save the credit of the higher races. Considering that small children tell lies, and that lies are told, if not in speech yet in acts, by dogs, considerable hardihood is shown in ascribing the truthfulness of these and kindred peoples to stupidity. In his *Highlands of Central India*, Forsyth writes:—

"The aborigine is the most truthful of beings, and rarely denies either a money obligation or a crime really chargeable against him."

Describing the Râmósîs, Sinclair alleges that—

"They are as great liars as the most civilized races, differing in this from the Hill tribes proper, and from the Parwârîs, of whom I once knew a Brâhman to say: 'The Kunabîs, if they have made a promise, will keep it, but a Mahâr [Parwari] is such a fool that he will tell the truth without any reason at all.'"

And this opinion expressed by the Brahman, well illustrates the way in which their more civilized neighbors corrupt these veracious aborigines; for while Sherwill, writing of another tribe, says—"The truth is by a Sonthal held sacred, offering in this respect a bright example to their lying neighbors the Bengalis," it is remarked of them by Man that—

"Evil communications are exercising their baneful influences over them, and soon, I fear, the proverbial veracity of the Sonthal will cease to become a by-word."

In *The Principles of Sociology*, vol. ii, §§ 437 and 574, I gave the names of others of these Indian hill-tribes noted for veracity—the Bodo and Dhimáls, the Carnatic aborigines, the Todas, the Hos; and here I may add one more, the Puluyans, whose refuge is "hemmed in on all sides by mountains, woods, backwaters, swamps, and the sea," and who "are sometimes distinguished by a rare character for truth and honor, which their superiors in the caste scale might well emulate." So too is it in a neighboring land, Ceylon. Wood-Veddahs are described as "proverbially truthful and honest." From other regions there comes kindred evidence. Of some Northern Asiatic peoples, who are apparently without any organization for offense or defense, we read:—"To

the credit of the Ostiaks and Samoieds it must be said, that they are eminently distinguished for integrity and truthfulness."

But now we have to note facts which make us pause. There are instances of truthfulness among peoples who are but partially peaceful, and among others who are anything but peaceful. Though characterized as "mild, quiet, and timid," the Hottentots have not infrequent wars about territories; and yet, in agreement with Barrow, Kolben says—

> The Word of a Hottentot "is sacred: and there is hardly any Thing upon Earth they look upon as a fouler Crime than Breach of Engagement."

Morgan, writing of the Iroquois, states that "the love of truth was another marked trait of the Indian character." And yet, though the Iroquois league was formed avowedly for the preservation of peace, and achieved this end in respect of its component nations, these nations carried on hostilities with their neighbors. The Patagonian tribes have frequent fights with one another, as well as with the aggressive Spaniards; and yet Snow says—"A lie with them is held in detestation." The Khonds, too, who believe that truthfulness is one of the most sacred duties imposed by the gods, have "sanguinary conflicts" between tribes respecting their lands. And of the Kolîs, inhabiting the highlands of the Dekhan, we read that though "manly, simple and truthful," they are "great plunderers" and guilty of "unrelenting cruelty."

What is there in common between these truthful and pacific tribes and these truthful tribes which are more or less warlike? The common trait is that they are not subject to coercive rule. That this is so with tribes which are peaceful, I have shown elsewhere (*Principles of Sociology*, ii, §§ 573–4); and here we come upon the significant fact that it is so, too, with truthful tribes which are not peaceful. The Hottentots are governed by an assembly deciding by a majority, and the head men have but little authority. The Iroquois were under the control of a council of fifty elected sachems, who could be deposed by their tribes; and military expeditions, led by chiefs chosen for merit, were left to private enterprise and voluntary service. Among the Patagonians there was but feeble government: followers deserting their chiefs if dissatisfied. Writing of the Khonds' "system of society" Macpherson says—"The spirit of equality pervades its whole constitution, society is governed by the moral influence of its natural heads alone, to the entire exclusion of the principle of coercive authority."

In the remarks of sundry travelers, we find evidence that it is the presence or absence of despotic rule which leads to prevalent falsehood or prevalent truth.

Reference to the *Reports on the Discovery of Peru* of Xeres and Pizarro (pp. 68–9, 85–6, 114–120), makes it manifest that the general untruthfulness described was due to the intimidation the Indians were subject to. So, too, respecting the Mexicans, the Franciscan testimony was—"They are liars, but to those who treat them well they speak the truth readily." A clear conception of the relation between mendacity and fear was given to Livingstone by his experiences. Speaking of the falsehood of the East Africans he says—

"But great as this failing is among the free, it is much more annoying among the slaves. One can scarcely induce a slave to translate anything truly: he is so intent on thinking of what will please."

And he further remarks that "untruthfulness is a sort of refuge for the weak and oppressed."

A glance over civilized communities at once furnishes verification. Of European peoples, those subject to the most absolute rule, running down from their autocrat through all grades, are the Russians; and their extreme untruthfulness is notorious. Among the Egyptians, long subject to a despotism administered by despotic officials, a man prides himself on successful lying, and will even ascribe a defect of his work to failure in deceiving some one. Then we have the case of the Hindus, who, in their early days irresponsibly governed, afterwards subject for a long period to the brutal rule of the Mahometans, and since that time to the scarcely-less brutal rule of the Christians, are so utterly untruthful that oaths in Courts of Justice are of no avail, and lying is confessed to without shame. Histories tell like tales of a mendacity which, beginning with the ruled, infects the rulers. Writing of the later feudal period in France, Michelet says:—"It is curious to trace from year to year the lies and tergiversations of the royal false coiner"; but nowadays political deceptions in France, though still practiced, are nothing like so gross. Nor has it been otherwise among ourselves. If with the "universal and loathsome treachery of which every statesman of every party was continually guilty," during Elizabeth's reign, while monarchical power was still but little qualified, we contrast the veracity of statesmen in recent days, we see a kindred instance of the relations between the untruthfulness which accompanies tyranny and the truthfulness which arises along with increase of liberty.

Hence such connections as we trace between mendacity and a life of external enmity, and between veracity and a life of internal amity, are not due to any direct relations between violence and lying and between peacefulness and truth-telling; but are due to the coercive social structure which chronic external enmity develops, and to the non-coercive social structure developed by a

life of internal amity. To which it should be added that under the one set of conditions there is little or no ethical, or rather pro-ethical, reprobation of lying; while under the other set of conditions the pro-ethical reprobation of lying, and in considerable measure the ethical reprobation, become strong.

THE PREHENSILE FOOT OF EAST INDIANS.

By M. F. REGNAULT.

THE traveler who walks in the native quarters of the cities of India can easily study there all industries in their beginnings, as they were probably practiced in Europe in the middle ages. The shops are usually open, and the workmen can be seen inside; textile industries, pottery, shoemaking, joinering, armoring, jewelry, confectioners—all can be observed in a single street like Chitpore Street, Calcutta. If we take pains to examine attentively the methods of working, we shall be struck by the enormous function played by the lower limb. Whatever the industries, the Indian, squatting or sitting on the ground, works with his feet as well as with his hands; and it might be said that all four of his limbs are in constant exercise. The joiner, for example, has no assistant to hold his plank, but makes his great toe serve that purpose. The shoemaker does not employ a fixed clamp for the shoe on which he is sewing, but holds it in his feet, which change position to suit his convenience, while his nimble hands do the sewing. The metal-worker holds the joint of his shears on his feet in cutting copper.

In the making of wooden combs I have seen the comb held straight up by the feet, while the workmen marked the teeth with one hand and with the other directed the instrument that cut them. The wood-turner directs the hand-rest with his great toes; so, generally, do Egyptian and Arabian turners. In smoothing twine or sewing a bridle the Indians hold the article between the first and second toes. When the butcher cuts his meat into small pieces, he holds his knife between the first and second toes, takes the meat in both hands, and pulls it up across the knife. I have seen a child climb a tree and hold a branch between his toes. These are enough details concerning the constant, universal use of the foot.

In considering this property of the lower limb, it is well to distinguish between the parts that relate, first, to the articulation of the hip, which, being very loose, permits the Indian to squat in such a position that his foot shall not be very far from his hands, so as to make all four participate in the work and permit the whole

lower limb to engage in wide movements. The position is very different from that of our tailors or of the Arabs. It brings the knees to a level with the chest. The man is supported on his ischia and his feet; and he keeps in this position for whole hours, while we can maintain it only for a few minutes. It is their way of resting, and we can see them by groups squatting in this manner, and smoking. In the second place, the articulation of the instep and the medio-tarsal permit wide lateral movements of the foot, as in

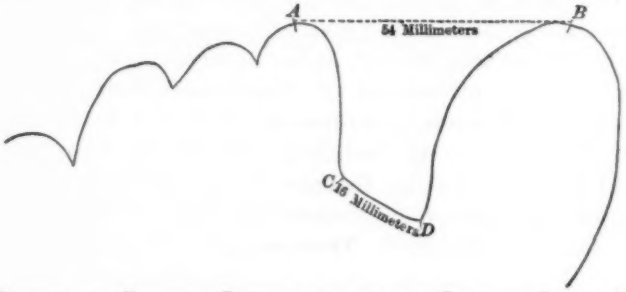


FIG. 1.—SHOWING THE ENORMOUS DISTANCE BETWEEN THE FIRST AND SECOND TOES IN A TAMIL OF TRICHINOPOLY.

the examples of the shoemaker, joiner, comb-maker, and turner; and on the toes, which are peculiarly flexible, as with the butcher cutting meat and the child climbing trees.

The great toe is capable of considerable lateral movements from the second toe, so that the Indian can easily pick up articles from the ground with his foot, and even exert some force sidewise.

But great as is their skill, there is no movement of opposition between the great toe and the other toes, as there is in the monkey. The great toe has very extended movements of adduction and abduction, and of elevation and depression, but all is limited.* The property is frequent among savages and half-civilized peoples. Broca pointed out in 1869 the part which the foot could be made to serve. Morice has remarked that the great toe of the Annamites could be used by them in picking up small objects; and he saw a boatman take his hand from the helm and steer very correctly with his foot, while he rolled his cigarette.†

In French and foreign treatises on anthropology I find Ranke's work, entitled *Der Mensch*, the only one in which the function of the toes as organs of prehension is mentioned; and the feet of Japanese rope-dancers and jugglers have been examined with reference to this point by Luce.‡ But the constant use

* Sir Richard Wallace says that, with all the savages he ever saw, he never observed movements of opposition.

† Bulletin de la Société d'Anthropologie, session of the 18th of February, 1875.

‡ Travelers have often mentioned similar facts in their narratives. Horsemen in Abyssinia, according to G. Pouchet, hold the straps of their stirrups between the first and sec-

of the foot in the industry of a people advanced in civilization does not appear to me to have been remarked.

The Ectromelians are able to use their feet after a long and patient education, but they seem to serve the part of supplementary organs. A report has been made to the Society of Anthropology (Bulletin, 1875) concerning the Ectromelian Ducornet, who, with only four toes, painted, holding his brush between his two middle toes. I saw one who was exhibited at Marseilles in 1889. He drank, ate, fired guns, played cards, wrote, and played on several instruments of music with his feet. On a closer examination of him it appeared, as is observed in all similar cases, that there was no movement of opposition of the great toe. A special anatomical peculiarity is connected with this physiological function of the foot—the distance between the first and second toes. Let us look into this feature among the Indians, taking for our example the extremely remarkable type of Fig. 1. It represents the foot of a Tamil in Trichinopoly, in which the space be-

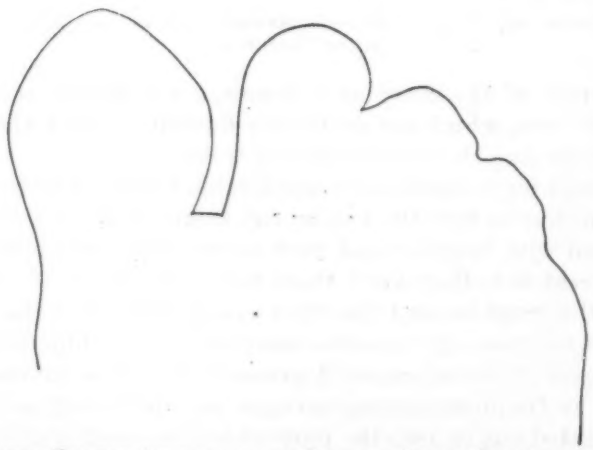


FIG. 2.—NEAREST POSSIBLE APPROACH OF THE FIRST AND SECOND TOES IN THE SAME TAMIL.

tween the first and second toes was very large from birth. Taking the middle of the extremity of the first and the middle of the second toe, I measured the two points A and B, the distance between which, on a foot placed in its usual position on the ground, was forty-nine millimetres in the right foot and fifty-four millimetres in the left foot. This does not depend upon a simple divergence of the ends of the toes; the base participates in it, and it seems to go back to the metatarso-phalangeal articulation. This distance apart of the toes at the base is fifteen millimetres on the right and sixteen millimetres on the left foot. When this Tamil

ond toes. In New Guinea, says D'Albertis, natives secure themselves in walking by hooking their great toe to a root or a bit of rock.

was asked to bring the two toes as near together as possible, he could not make them touch; there was still a space between them, as in Fig. 2. All gradations may be observed between this maximum of separation and a foot on which no separation can be perceived in ordinary attitudes.

Among thirty-seven persons examined in Pondicherry, I only found eight in whom there was a separation. It is therefore not constant in the Indian race. The distance between the ends of the toes may vary in the same person by ten or even by twenty millimetres, accordingly as they are drawn together or apart by the muscles of the foot alone, and without using the hand. They may usually be made to touch when brought together. But it will be observed that they only touch at the ends. At the root the separation persists. The distance between the toes, there, may be diminished, but does not vanish, when they are brought together, and it may be increased when they are spread out.

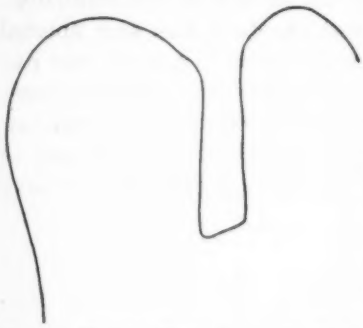


FIG. 3.—NORMAL POSITION OF THE FOOT.

Figs. 3, 4, and 5 illustrate these facts. They are accurate, being the traces, taken with a pencil, of the toes in different positions; and it should be kept in mind that the separation and the drawing together are due solely to the action of the muscles of the foot.

This anatomical disposition may occur in other Indians as well as in Tamils. I have found it among the Bengalis, in three of whom I have drawn it, but it is not frequent among them. With none, however, in all my investigations, have I found it as strongly accentuated as with the Trichinopolitan whom I have used as a type. It appears to be rare among the Singhalese, but their feet have the prehensile property.

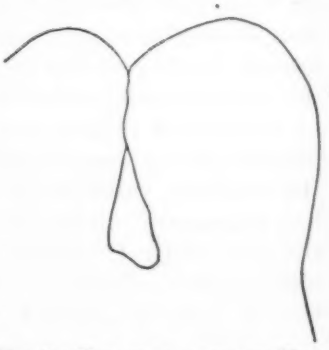


FIG. 4.—THE SAME, WITH THE TOES BROUGHT TOGETHER.

An interesting point in the feature is the possibility, by means of it, of using a peculiar patten, which consists of a flat piece of wood cut in the form of the foot, with a peg between the first and second toes, by which the shoe is held on. It is used only in the low castes. Four pairs of these pattens may be seen in the collection of shoes in the Cluny Museum. In two of them the peg is

tipped with an ivory button, one having four lobes and the other six, which give them a resemblance to a lotus flower. These lobes open under the pressure of the foot, and thus form a kind of fastening. Pattens of this kind are used only in the Indies. A European would find it very hard to wear them.*

The separation of the great toe at the base is not special to the East Indians. M. Manouvrier has reproduced it on two drawings of the feet of Caribs on exhibition in the *Jardin d'acclimatation;* but this author has not observed that the foot has any special part with this people as an organ of prehension. Among the numerous casts of feet in the museum of the *Société d'Anthropologie* are some very interesting impressions of the feet of Annamites, presented by M. Mondière. The separation on the foot of one of these Annamites, named Van, is very marked. It measures twelve millimetres at the base of the first and second toes, and forty-one millimetres, taking the middles of the nails as points of measurement, at the tips (Fig. 6). On the impression of the foot of another Annamite, named Thi-Finhi, the separation is less notable, but is still four millimetres at the base and forty-one millimetres at the ends; while a third impression, still by M. Mondière, shows a still different degree of separation. This separation has been noticed frequently among the Annamites, as well as the prehensile faculty of the foot. They therefore enjoy that property in common with the Indians.

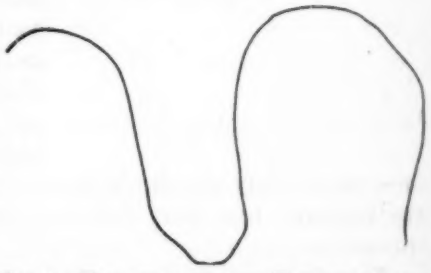


FIG. 5.—THE SAME, WITH THE TOES SPREAD OUT.

It does not follow, however, that this faculty is common to all peoples that go barefooted, or even to all savages. There are at the museum castings of three feet of negroes in which nothing like it appears; an American Indian foot from the lower Amazon, the gift of Dr. Crevaux, also normal; two feet of young Bushmen, normal likewise; and thirteen feet of Fuegian men and women, normal. Only in the cast of the right foot of one young

* The pattens worn in China, Japan, and Burmah somewhat resemble these. They, too, can be seen in the Cluny Museum. Three of the specimens there were held to the foot by strings, one part of which was fixed to the shoe between the first and second toes, while the other part, passing over the back of the foot, ended in the side of the shoe. These sandals resemble those of the ancient Greeks and Romans, as we see them in works of art. The separation of the great toe from the others in Japanese stockings is explained by this construction. It is to enable the pattens to be put on. But the abduction force of the great toe is not utilized in these as it is in the Indian pattens. The shoe is held by strings to the sole of the foot.

man did I find a separation of four millimetres at the base of the first two toes. The *École d'Anthropologie* has several traces of feet taken by M. Manouvrier among Fuegians, Araucanians, Omahas, and Arabs of Algeria and Morocco, in none of which is there any example of this anatomical peculiarity. I have not observed it in any European or in any white child.* The habit of walking barefooted may produce a slight divergence of the great toe, but not at the base. The function of prehensibility must therefore be considerably developed for such a divergence to exist. Still, heredity appears to have a part in it; for we do not observe it except among peoples who have exercised the function from a remote antiquity. It would be interesting to dissect a foot presenting this formation and compare it with the foot of a white. We should most likely find the oblique and transverse abductor muscles very highly developed. It is a current fact that exercise strengthens the muscles.

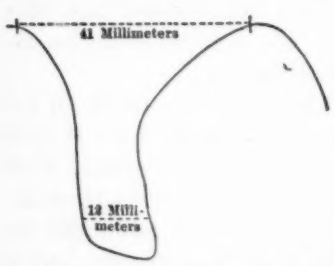


FIG. 6.—THE FIRST AND SECOND TOES OF THE ANNAMITE VAN.

It would also be desirable to learn the origin of the separation at the base of the first and second toes. It can not be caused, as in the monkey, by the head of the first metatarsal playing on that of the second, for there is no movement of opposition here. It all takes place in the metatarso-phalangeal articulation. M. Testut, in a work on the Quaternary skeleton of la Chancelade, remarks that the anterior articular surfaces of the metatarsi which are destined for the phalanges are more extended, in length as well as in breadth, than those which have been observed on the metatarsi of European races. Unfortunately, we have data only for the articular surfaces of the last four metatarsi—the first, the one that interests us, having probably been suppressed. M. Testut concludes that this disposition is related to the mobility of the toes on the metatarsus—a mobility which has probably been considerably diminished in man since he has made his foot exclusively an organ of support. Whether the skeleton of the Indian is like this, and whether the separation of the base of the toes can be explained in this way, suggest hypotheses which dissection alone can verify.

The examination of the prehensile foot suggests forcibly the thought of comparing it with the foot of the monkey. The difference between the opposable foot of the monkey and the foot of man has been variously explained. The non-transformists base

* The movements of the toes are well developed in new-born children; but I have never observed, in children's hospitals, any trace of opposition.

upon it an argument against the application of the transformist theory to man. Some Darwinians believe that if man used his foot constantly and generally as a prehensile organ, an opposition of the great toe would be gradually evolved in the adaptation of the organ to that function. The preceding study, however, proves that this is not the fact. Among a people who have for centuries commonly used their feet as a prehensile organ no movement of opposition has been produced; while in some persons an adaptation to the new function has been observed, namely, a separation of the great toe and wide and strong lateral movements, but only lateral—a pincers-foot, not a hand-foot. It will be seen, on reflection, that the condition could not be otherwise.

In walking, the weight of the body is borne on the heads of the five metatarsi, but mostly on the head of the first one. If that was not united solidly to the second metatarsus, and could turn around it as is done in the hand, it would give way every time the foot touched the ground, and the foot would want a sufficient internal point of support; walking would still be possible, but it would be hard and laborious—occasional, and not a habitual normal act. It is thus with the monkey, which is supported solely on the outer edge of the foot. Even the anthropoid walks rarely and awkwardly; its foot, adapted to living in the woods, has the opposition movement convenient for climbing easily; it has a foot-hand. The man who, continuing to walk, likewise wants a prehensile foot, can not enjoy this movement, which is incompatible with walking. He satisfies himself with lateral movements between the great toe and the second toe, or a pincers-foot. All this is simply a consequence of the general biological law of the adaptation of the organ to the function.—*Translated for The Popular Science Monthly from the Revue Scientifique.*

A CURIOUS, secretive proceeding of swans is described in Nature by Jessie Godwin-Austen. The cygnets having been just hatched out, the male bird picked up an empty half egg-shell lying beside the water and carefully carried it to the edge of the water some twenty feet from the nest, filled it with mud, and pushed it into the river, where it sank to the bottom; and then repeated the performance with the other half egg-shell. On returning to the nest the last time, he placed a few sticks across the small track he had made. As no other pieces were seen about the nest, while five cygnets were hatched, it is inferred that the bird had done the same with all the egg-shells.

A PAPER by Mr. Edward Dobson, in the Australasian Association, on Human Habitations in Prehistoric Times, was devoted to showing that, while rectangular forms prevailed in the early buildings of the East and in North America, the circular form had prevailed throughout Africa (with the exception of the Nile Valley) and through Switzerland and northern Europe, in Lapland and Greenland; and raised an inquiry as to the causes of these facts.

MANUFACTURE OF BOOTS AND SHOES.

By GEORGE A. RICH.

XVI. DEVELOPMENT OF AMERICAN INDUSTRIES SINCE COLUMBUS.

WITH all the uses to which leather is put, that of making boots and shoes is the most important, and calls for the greater part of the product of the tanneries of the country. It is not only the most important in point of magnitude, but it is one which has opened an unusual field for American ingenuity and invention. When the late Charles Stewart Parnell was in this country some years ago, he expressed a desire to see what could be done in an American shoe-factory. Accordingly, what is known to the trade as a Polish lace boot was selected by the Lynn manufacturer, whose building Mr. Parnell was inspecting, as the pattern to illustrate the processes of the art and the speed of the work. Mr. Parnell hastened from one part of the factory to another as the boot in its evolution flew hither and thither, and within twenty minutes after he had seen the pattern placed upon the leather the finished article was handed to him. That, of course, was an exhibition not practicable in ordinary, every-day work. But, compared with the time it would have required to make the boot by hand, it points to the saving that has been effected through the introduction of machinery and emphasizes the mechanical and economical development of the industry. As in the case of tanning, these advances are of comparatively recent origin, dating largely from the civil war and the scarcity of labor consequent upon it. But, though brief the time, the advance from the shoemaker of forty years ago with his hammer and lapstone, to the factory of the present day with its multiplicity of machines and its hundreds of operatives, has been a wonderful one. Indeed, within that period is crowded more in the way of progress and development than is to be found in all the centuries which intervene between the time of the Egyptian cobbler and that of our grandfathers.

There is no article of dress in which more striking changes have been made in the various ages than in the covering for the feet. Until the law was invoked, boots and shoes seemed to be the special field in which the whims of fashion manifested themselves. Coverings for the feet must have been among the earliest articles of dress. It is almost impossible to conceive of a time when ever-recurring injuries from contact with the earth's surface did not suggest some such protection. The primitive form of foot-covering was the sandal, which was simply a flat sole under the foot and secured to it by a thong. These were made of a great variety

of materials. The Egyptians used palm leaves and leather, while the Hebrews preferred linen or even wood. Brass and iron were not found objectionable by some, and in a few instances gold was employed for that purpose. Like the sandal, the shoe grew out of physical conditions, the fundamental purpose of it being protection for the whole foot. Among the early Greeks and Romans shoes were not common, but the wearing of them once established, an endless variety arose—law and fashion dictating special styles and finish for the several social ranks and classes. A single hide, slit and looped into a purse-like pouch by a thong run through it, seems to have been the primitive form of the shoe in Great Britain. Boots and shoes became common in Europe between the ninth and sixteenth centuries, and the fantastic forms which they assumed,

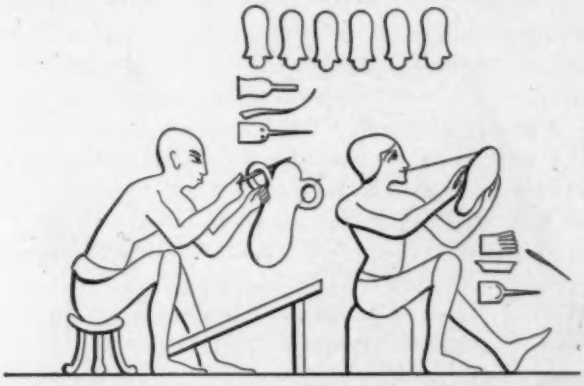


FIG. 1.—ANCIENT EGYPTIAN COBBLERS AT WORK. The familiar awl, lapstone, and thread appear in this. Even the method of drawing the thread is not unknown to those who have ever frequented an old New England cobbler's shop.

and the laws in restraint of them, show the prominent place they had come to occupy in the wardrobe and fashions of the day.

It was not to be expected that there would be a serious demand on the part of the early settlers in this country for these more fashionable styles of boots and shoes. Those who could afford to do so brought with them such articles for holiday and Sunday use, just as they did their velvet breeches and brocade gowns and bits of old lace. But there was a need from the first for stout boots and shoes, both as a protection against the cold and against injury on the rocks and rough soil. Some of the settlers were quick to adopt the moccasin of the Indian; but, though warm and easy to make, it did not meet the ideas of the Europeans. Accordingly, the shoemakers were among the first craftsmen to settle here, and from the privileges that were accorded them from the start their number and influence may be inferred. The early records of Virginia, New York, Pennsylvania, and Massachusetts all bear evidence to their presence and to the establishment of their trade.

But it was in the last State, at Lynn, that the industry had its real origin and center in this country.

Philip Kertland was the first person of that craft to locate in what was to develop into the "City of Shoes," coming thither from Sherrington in Buckinghamshire, England, in 1638. He was joined soon after by Edmund Bridges, and considerable of a local business sprang up. At that time shoemakers went around from house to house and worked up the family stock of leather, but this itinerant system was soon dropped by the Lynn craftsmen as their business grew into more than a local one. The art of shoemaking, however, was not understood and the workmen were unskilled. Occasionally some of the more ambitious ones would send to England for shoes and take them apart, with a view of learning the way of making them. But men who had money and were in a

FIG. 2.—AN EARLY LYNN SHOE-SHOP. These shops marked the intermediate stage in the evolution of the shoe industry. With the introduction of machinery, between 1860 and 1870 they passed out of use and largely out of existence.

position to help on such experiments were shy of the shoe business. They preferred to invest in trade and real estate. The result was that no real progress was made in the business until John Adams Dagyr, a Welsh shoemaker, moved to Lynn in 1750. Dagyr was skilled in the methods employed in England, and he proceeded to instruct all who came to him in the art. His fame spread abroad through northeastern Massachusetts, and it was only a short time after his settlement before a notable improvement became apparent in the Lynn product. The Boston Gazette of October 21, 1764, said: "It is certain that women's shoes, made at Lynn, do now exceed those usually imported, in strength and beauty, but not in price." Edward Johnson, of Woburn, in his "Wonder-working Providence," says of Lynn: "All other trades have fallen into

their ranks and places, to their great advantage, especially coopers and shoemakers, who had either of them a corporation granted, enriching themselves by their trades very much. As for tanners

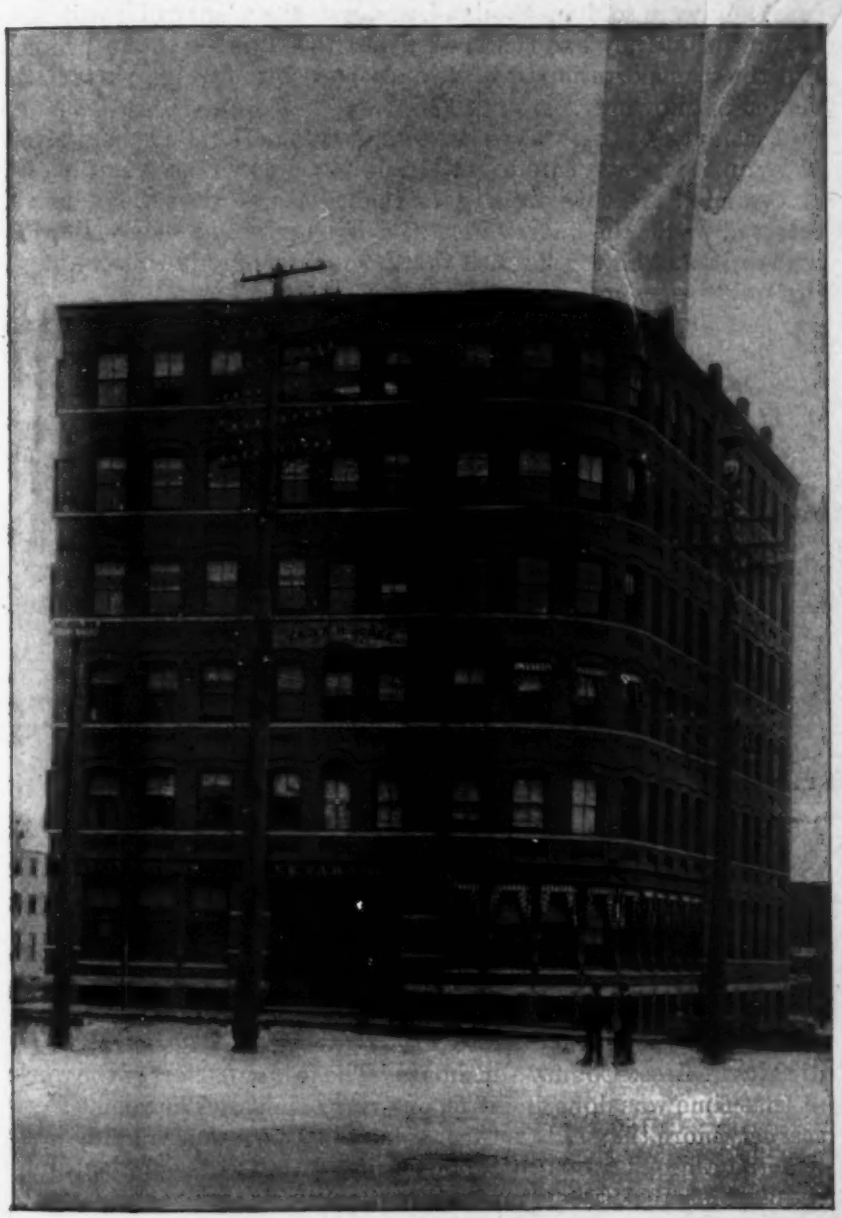


FIG. 3.—A FACTORY OF TO-DAY.

and shoemakers, it being naturalized into their occupations to have a higher reach in managing these manufactures than other men

in New England are, having not changed their nature in this, between them both they have kept men to their stand hitherto, almost doubling the price of their commodities, according to the rate they were sold in England, and yet the plenty of leather is beyond what they had there, counting the number of the people. But the transportation of boots and shoes into foreign parts hath vented all, however."

Inasmuch as this was written only a year after Dagyr's arrival at Lynn, it is pretty safe to set Mr. Johnson down as something of an optimist. But it points to the immediate impetus the industry received under the latter's hand. Yet, by a strange irony, Dagyr, who did so much to establish the shoemaker's art in this country,

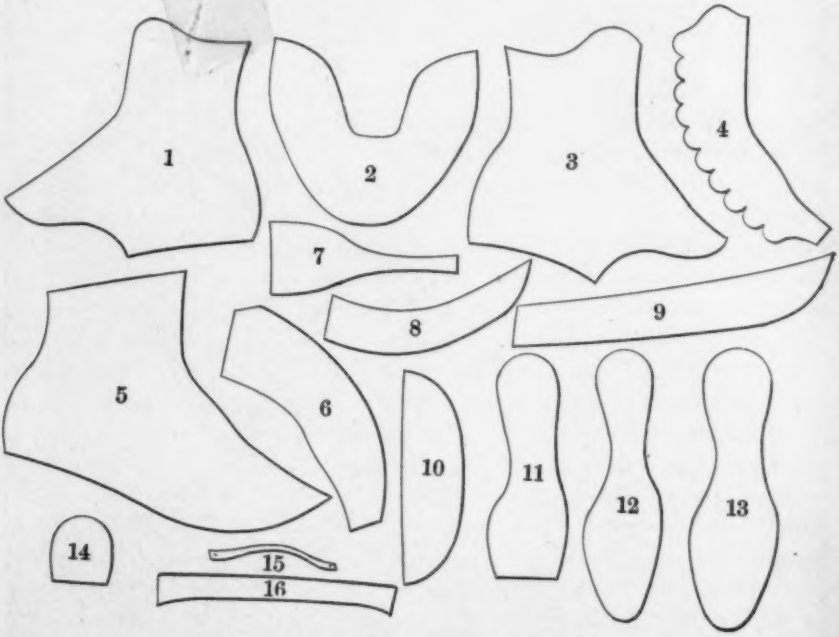


FIG. 4.—PARTS OF A BUTTON SHOE. 1, Large quarter; 2, vamp; 3, small quarter; 4, button piece; 5, drill lining; 6, glove button-piece lining; 7, heel lining stay; 8, button stay; 9, top stay; 10, heel stiffener; 11, sole lining; 12, inner sole; 13, outer sole; 14, heel lifts (six); 15, steel shank; 16, rand.

died in the Essex County almshouse. The principal part of the work at that time was done in little, one-story shops. The rooms were scarcely more than a dozen feet square, with windows at sides and end and a broad fireplace in one corner. They were good-natured, industrious, thrifty companies that filled those shops. Fishermen and farmers and those trained "to the last" were all represented. Journeyman and apprentice, master and workman, stood on the same footing and shared alike. These shops stand, economically and mechanically, between the home and the factory. Shoes were

still sent to the houses of the farmers to be finished, and some of the shops turned out work enough to entitle them to the more ambitious name which is attached to such establishments at the present day. Other towns about Lynn followed its lead; and Marblehead, Danvers, and Haverhill soon became actively engaged in the industry. Women's shoes were then—as they have ever continued—the staple article of manufacture at Lynn. These were made largely of stuff, the finer qualities with white and russet rands, stitched firmly with white waxed thread, pointed at the toes, and adorned with wooden heels covered with leather.

FIG. 5.—SECTION OF A MAN'S BOOT. *a*, The upper; *b*, in-sole; *c*, out-sole; *d*, welt; *e*, the stitching of the sole to the welt; *f*, the stitching of the upper to the welt.

That England felt this growing industry of the colonies is shown by the fact that a commission was appointed to inquire into the reason why no more boots and shoes were exported to America. It was with astonishment that the gentlemen composing the commission reported to their colleagues that the colonists were supplying their own foot-wear, and apparently, too, with satisfaction to those concerned. Then came England's desperate efforts to force the trade of the colonies into British channels and the consequent resistance of the latter to such coercion. Under the influence of the import duties, the shoe industry flourished especially, and at the time of the Revolution the manufacturers were unable to meet the demands which were made upon them for boots for the Continental army. But following that came a serious check. The American markets were flooded with English goods, and trade was paralyzed. A demand was then made on the part of the shoe manufacturers for some kind of protection, with the result that, in the first Congress, in 1789, a tariff was arranged so as to check importations. Hon. John B. Alley, of Lynn, at a leather-trade dinner in New York in 1859, gave somewhat of a romantic version to that portion of the tariff affecting boots and shoes—a version which possibly is not to be accepted in detail as history, but which is, nevertheless, of interest. He said that this early duty on imported boots and shoes was due largely to the efforts of Ebenezer Breed, a young Lynn shoemaker, who had located in Philadelphia on account of the dull times in his own town, and of his friend Stephen Collins, a native of the same place. By their influence with members of Congress and with Dolly Payne, the young Quakeress, to whom Mr. Madison, then a rising man in public legislation, was at that time paying attention, they got this boon for their home industry. Be that as it may, with the cessation of imports the Massachusetts shoe-shops

began to expand rapidly, and goods were shipped not only to Boston, New York, and Philadelphia, but even to Liverpool. Lynn, in 1788, exported 100,000 pairs of shoes; while, seven years later, the volume of transactions had increased to 300,000 pairs, and there were at that time 200 master workmen and 600 journeymen and apprentices engaged in the making of them.

But, with all this development of trade, boots and shoes continued to be made by hand. Spasmodic attempts were made to abbreviate the processes, but nothing satisfactory resulted from them for many years. Mr. David Knox, writing in a shoe journal of his experiences as a manufacturer, says: "In 1855, the year in which I commenced business, about the only machinery used in shoe manufacturing were the sewing machines to stitch uppers and the machines to strip leather and cut it into soles. Even these were not in general use. Some manufacturers had introduced revolving cutters—in Lynn the Richards and Foster machines, and in Marblehead the Thompson. With the Foster and Thompson machines soles could be cut reasonably quick, but such was the risk of the operator's fingers being chopped off by the erratic movements of the knives that the old Thompson or Ingalls beam was preferred. By very hard work on these machines about fifteen pairs of soles could be cut per minute, while on the modern machines, operated by steam-power, as many as ninety pairs are cut in the same time, and with vastly more accuracy."

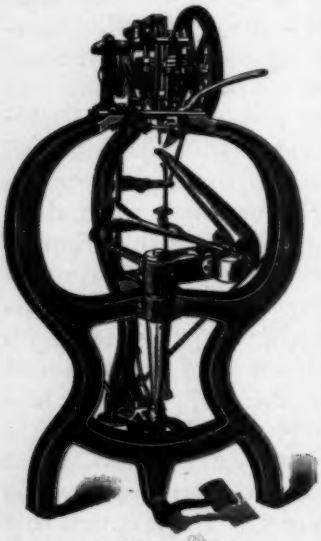


FIG. 6.—MCKAY STITCHING MACHINE.

The chief tools of the shoemaker then consisted of his hammer, his awl, his lapstone, his knives, and his harness for "setting-up" his boots or shoes. The essentials of a shoe are the upper, the sole, the counter or heel stiffening, and the heel. These parts are again subdivided into the "vamp" for covering the front of the foot, the large and the small quarters for encircling the ankles, the button-piece, etc. The work of the shoemaker is to prepare and close these various parts of the upper and the linings together, to bring them into the desired shape, to fasten them to the sole which has been previously cut, to attach the heel, and then to give the various parts the desired finish and style. These processes indicate the lines along which machinery had to be applied. All the operations have been subdivided to the minutest detail, and in the performance

of all of them machines—more or less satisfactory in their workings—have been devised. The parts of the uppers are now sewed together by machinery, and they are pegged, sewed, or screwed to the sole by machinery. Instead of the lapstone and the hammer for condensing the leather are now swiftly revolving rollers, and instead of the patterns for cutting out the soles are dies or sole-shaped knives set in machines.

But the field of shoe machinery is such a wide and complex one that it will be impossible to do more than glance at what may be termed the epoch-making inventions. The first great step was made when the sewing machine was invented and the alert manufacturers were able to turn it to their purposes. But the distinction of the sewing machine does not belong to the shoe manufacturers. The invention, however, which did determine their future was that which led to the fastening of the sole of the shoe to the upper by machinery. The solution of this problem had been the real difficulty in the way of applying machinery to the work, and when it had been met the single-story shoe-shop had made way for the factory; its dozen journeymen had lost their individuality in the hundreds of operatives, and the pin-money which the wives of the farmers, or the farmers themselves, had made from the job-work doled out to them by the manufacturers had become a thing of the past. From that dates the shoe industry of to-day. From it also have come the growth and prosperity of important communities in Maine, New Hampshire, and Massachusetts, in New York, Pennsylvania, and the older West. As in the solution of most such problems, it was not hit upon at once. There were failures which were the forerunners of nothing, and failures which were the forerunners of success.

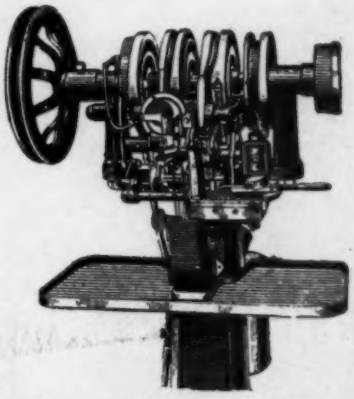


FIG. 7.—GOODYEAR STITCHING MACHINE. This is one of the machines in what is termed the Goodyear welt system.

Two of these latter are worthy of note, as they contained within them the suggestions which, a half-century later, were put into practical operation. The first of these attempts was made in 1809 by David Meade Randolph. He devised a way for fastening the soles and heels to the inner sole by means of nails. His plan was to use lasts covered at the bottoms with metallic plates, so that the nails, when drivén through the soles, were clinched on this piece of metal. The next year Mark Isambard Brunel, the eminent engineer, carried this idea a step further. He

FIG. 8.—SCENE IN A STITCHING ROOM.

fastened the soles to the uppers by nails, and, in order to do this, the leather was pressed between clamping plates of the same shape as the sole, the margin of the plate acting as a guide for a knife by which the sole was cut to the desired pattern. This sole was afterward clamped to a last, and there brought under the action of an awl and plunger operated by a lever. The sole-fastenings, usually nails, had to be placed in these awl-holes by hand, and were then driven in by the plunger, the awl at the same time making another hole for the next nail. Devices were also made for spacing the holes and clinching the nails on the inside of the shoe; but the shoes thus made proved unsatisfactory, the nails in them working loose.

In the actual solution of this problem two courses were pursued, the extension of the principle involved in the Randolph and Brunel devices and the application of the principle of the sewing machine. From the development of the one have come the pegged, nailed, and screwed boot and shoe; from the other, the stitched ones. In point of order the pegging machine came before the sole-sewing machine, standing as the invention of A. C. Gallahue, and under the date of 1851. Its operations were essentially the same as those of the cobbler who pierces the hole through the sole of the boot before him with his awl, and then, taking a peg from the generous store with which he has previously filled his mouth, drives it home with his hammer. Joseph Walker, of Hopkinton, Mass., had invented the shoe-peg about 1818, and it had commended itself to the craft at once. Machines were made for the manufacture of the pegs, and so thrifty were some of those engaged in their production that it is said they were sold in certain sections of the country not only as shoe-pegs but as a new kind of oats. Gallahue's machine included a cylinder on which were wound, like the spring of a watch, ribbons of birch of the same width as the length of the peg and sharpened on one edge. These were fed to the machine which, with knife, awl, and plunger, split the strips into widths of a peg, made a hole in the sole, and drove the peg into the shoe jacked beneath. Gallahue's invention was perfected by Messrs. E. Townsend and B. F. Sturtevant, of Boston. This idea has been still further developed in machines for riveting the two parts of the shoe together, the nails being clinched by coming in contact with an iron last, in a way suggestive of Brunel's method, and in machines for screwing them together. The screw machine, which came into use about 1875, is provided with a reel of stout screw-threaded brass wire, and this by the revolution of the reel is inserted into and screwed through the out-sole, upper edge, and in-sole. Within the upper a head presses against the in-sole directly opposite the point of the screw, and, when screw and head touch, the wire is cut level with the out-sole.

The first decisive step in sewing the sole and upper together was taken by Lyman R. Blake in 1858, his machine being perfected as the McKay sole-sewing machine. The machine, as described by Blake in his application for an English patent, "is a chain-stitch sewing machine. The hooked needle works through a rest or supporting surface of the upper part of a long, curved arm which projects upward from the table and the machine. This

FIG. 9.—THE CUTTING ROOM.

arm should have such a form as to be capable of entering a shoe so as to carry the rest into the toe part as well as any other part of the interior of it. It carries at its front end and directly under the rest a looper, which is supported within the end of the arm so as to be capable of rotating or partially rotating round the needle, while the needle may extend into and through the eye of the looper, such eye being placed in the path of the needle. The thread is led from a bobbin by suitable guides along the curved arm, thence through a tension spring applied to the arm, and thence upward through the notch of the looper. The feed-wheel, by which the shoe is moved along the curved arm during the process of sewing, is supported by a slider extending downward from the block and applied thereto so as to be capable of sliding up and down therein. The shoe is placed on the arm with the sole upward." In less technical language, the machine consists of a combination of wheels so arranged as to drive an awl-like needle through several thicknesses of heavy leather, and feed a waxed thread in any direction. The shoe itself rests upon the end of the

arm or horn noted in the above description, from the interior of which is supplied the waxed thread previously heated by a gas-jet within. But Blake's first machine was very imperfect. A leading interest in the invention, however, happened to fall into the hands of Mr. Gordon McKay. Realizing the importance of the principle, the two set themselves to its improvement. As perfected, they got patents on it in 1860, which gave them the practical control of the machine-made boots in this country for many years. It is said that nearly two hundred thousand dollars were spent on the invention before anything was realized from it. But when the return came it was indeed a golden harvest. None of the machines were sold outright to manufacturers, but they were let to them on the payment of royal-

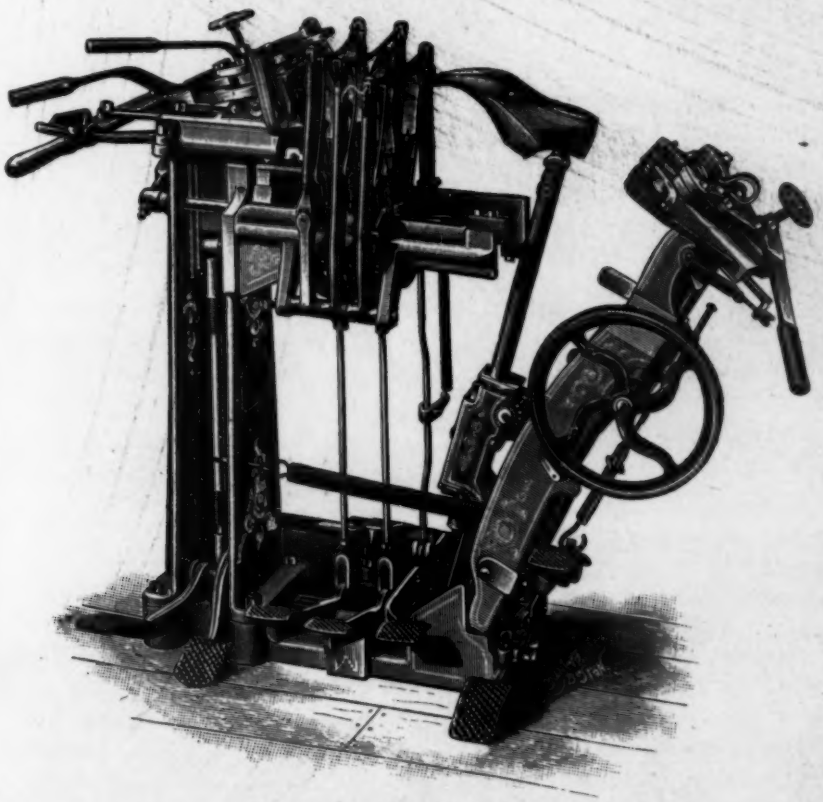


FIG. 10.—COPELAND RAPID LASTER.

ties; and to show what that amounted to is the fact that one Lynn manufacturer in a single year paid the company fully fifteen thousand dollars for the use of McKay machines in his shop. Under the pressure of the war the demand for boots and shoes of stout quality but cheaper grade was enormous, and it

Fig. 11.—Putting on the Heels.

was largely to that class of work that the McKay machine was turned.

The close way in which the McKay machine was held tended to check further improvements for a time. The suggestions afforded by it and its success, however, were open to all, and several inventions were later offered to the public. Most important among these were the Goodyear and McKay machines for welted sewing, the first mechanism for stitching the soles on lasted shoes. In Fig. 5, which represents a section of a boot, *a* is the upper, *b* the in-sole, and *c* the out-sole, while *d* is the welt, *e* the stitching of the sole to the welt, and *f* the stitching of the upper to the same. Following the process of lasting—that is, after the upper has been carefully drawn over the last—the welt is put in position around the sides up to the heel. The thin edge of this is then caught together with the upper and inner sole. The out-sole is afterward tacked to the in-sole and, through a narrow channel made around the edges of it, sewed to the welt. The difficulties in the way of getting a machine which would do this, not simply as well as the hand, but do it at all, were many. The method which finally succeeded originated in a patent secured in 1862, by August Destory, for a curved-needle machine for sewing out-soles to the welts; but the machine did not work satisfactorily until it was taken in hand by Charles Goodyear, the son of the inventor of the India-rubber processes. This machine simply transforms the swinging movements of the hand and forearm in sewing into lateral and vertical ones, but the principle in the two operations is identical. There is one difference which in a way may be said to be even a point in favor of the machine sewing. In hand sewing the thread is drawn clear through its full length each time, and thus is weakened by constant wear. In the machine, only so much is drawn through as is necessary to form the stitch. These machines have been perfected and multiplied until what is known as the Goodyear system is the result. This system includes machines for sewing the welt on, attaching the sole to the upper, for lasting the upper, for

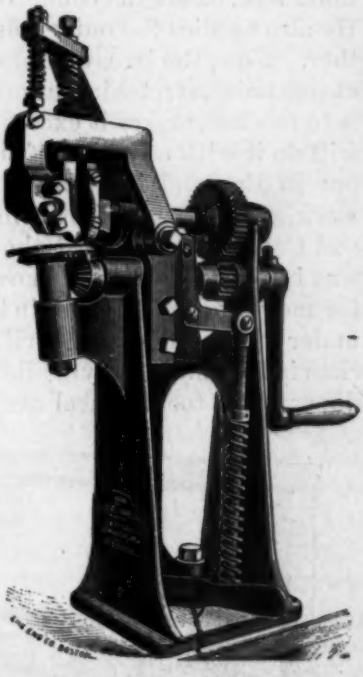


Fig. 12.—In-sole Channeler.

channeling or making the groove in which the stitching uniting the sole and upper runs, and for sewing turned shoes or work in which there is only one flexible sole attached to the upper, and done with the outside turned in.

Lasting has been the most difficult of all the operations from which machinery has attempted to rout hand-work. The work of the laster is to pull the upper tightly over a last, adjust to it the inner sole, insert the counter-shank, and fasten the upper in place. He also applies the outer sole to the upper, but does nothing further. Now, the irregular shape of the upper, requiring looseness at one point, stretching here and pinching there, in order to shape it to the last, makes it exceedingly hard to secure a machine which will do it with any kind of success. Patents, however, were taken out in England in 1842 for a machine intended to perform this work, and these were issued in this country in 1862. Messrs. McKay and Copeland purchased those rights in 1872, and ten years later was introduced what is known as the Copeland laster, a machine for men's work. The shoe in this machine lies in a kind of matrix, under which are leather girth straps attached to iron fingers. The shoe is held stationary while these fingers move up, inward, and down. The toe and heel are lasted by plates which are mounted on a table that oscillates and adapts its motion to the last. But it is not entirely machine-work, as hand-pincers are used to bring the uppers to the last. For women's and misses' shoes the Boston Lasting Machine Company has a different invention. The shoe in that case is lasted on a jack, the upper being drawn over by pincers, and the shoe itself is afterward brought up to the nozzle of the machine, contact with which starts some automatic tack-driving machinery, and the shoes are fastened as shaped with great rapidity. But manufacturers say that there is much to be accomplished yet before the perfection of hand-work is secured and the fingers and pincers can be entirely dispensed with.

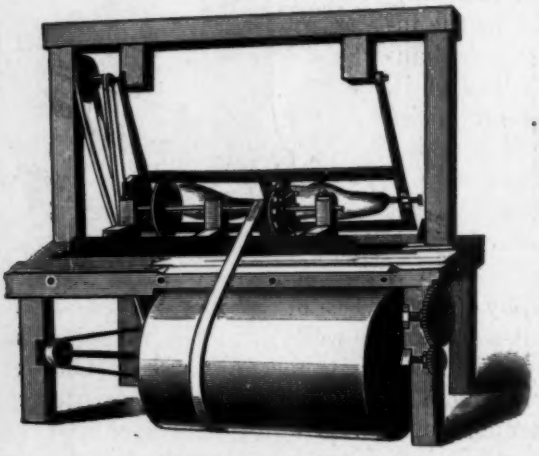


FIG. 13.—FIRST LATHE FOR TURNING LASTS.

The making of these lasts is a considerable industry in itself. Each manufacturer carries a stock of from two thousand to four

thousand of them, and they have to be changed with every variation in the style. Originally shoe-lasts were whittled out of rough blocks of wood by hand, but in 1815 Thomas Blanchard, well known in his day as an inventor, devised a lathe for turning them out by a less laborious process. A pattern had first to be made, and then this and a block of wood were fixed on the same axis and made to revolve around a common center in a swinging lathe by a pulley and belt on one end of the axis. The cutting wheel turned on a horizontal axis, and to it were attached a number of irregular cutters which acted like gouges when the wheel was set in motion. This wheel was placed opposite the block, while opposite the pattern was a friction-wheel of the same size. By the combined movements of this axis and a sliding carriage the irregular surface of the pattern caused the axis on which the friction-wheel was to alternately approach and recede, and this motion was in turn communicated to the knife-wheel. The result was that a duplicate of the pattern was produced from the block of wood. The last lathe has been improved since in many ways, but they are all based on the principles introduced by Blanchard.

It is impossible to more than name some of the other machines which have been introduced and which have done much to hasten the manufacture and reduce the cost of foot-wear. The sole-die machine was introduced about 1851, operated first by foot-power and later by steam. The buffing machine, a sanded cylinder for the purpose of giving a velvety finish or "nap" to the bottom of the sole, followed in 1855, and the eyeleting machine in 1864. Other machines of more recent date are the beating-out machine, between the forms of which the sole of the shoe, after the channel groove has been filled with naphtha cement, is subjected to enormous pressure; the trimming machine, whose revolving knives remove the rough edges of the sole; the burnishing machine, and the heeling machinery. It can not but be a source of gratification to Americans that the most of these inventions have had their origin on this side of the ocean, and that those that did not so originate have received their greatest development here. The experiments in England with the sewing and nailing machines had not enough success to warrant any serious claim to the invention. The American shoe-factory is the triumph of American ingenuity. There is no better word than "ingenuity" to describe it. It stands for the discovery of no new principle in mechanics. It represents the utilization of no new force in Nature. But it does contain within it some of the most remarkable adaptations of mechanical principles already known and the most marvelous devices for supplanting the work of the fingers. A modern shoe-factory would make a fitting monument for the Patent Office.

To realize how the introduction of machinery into the tanning

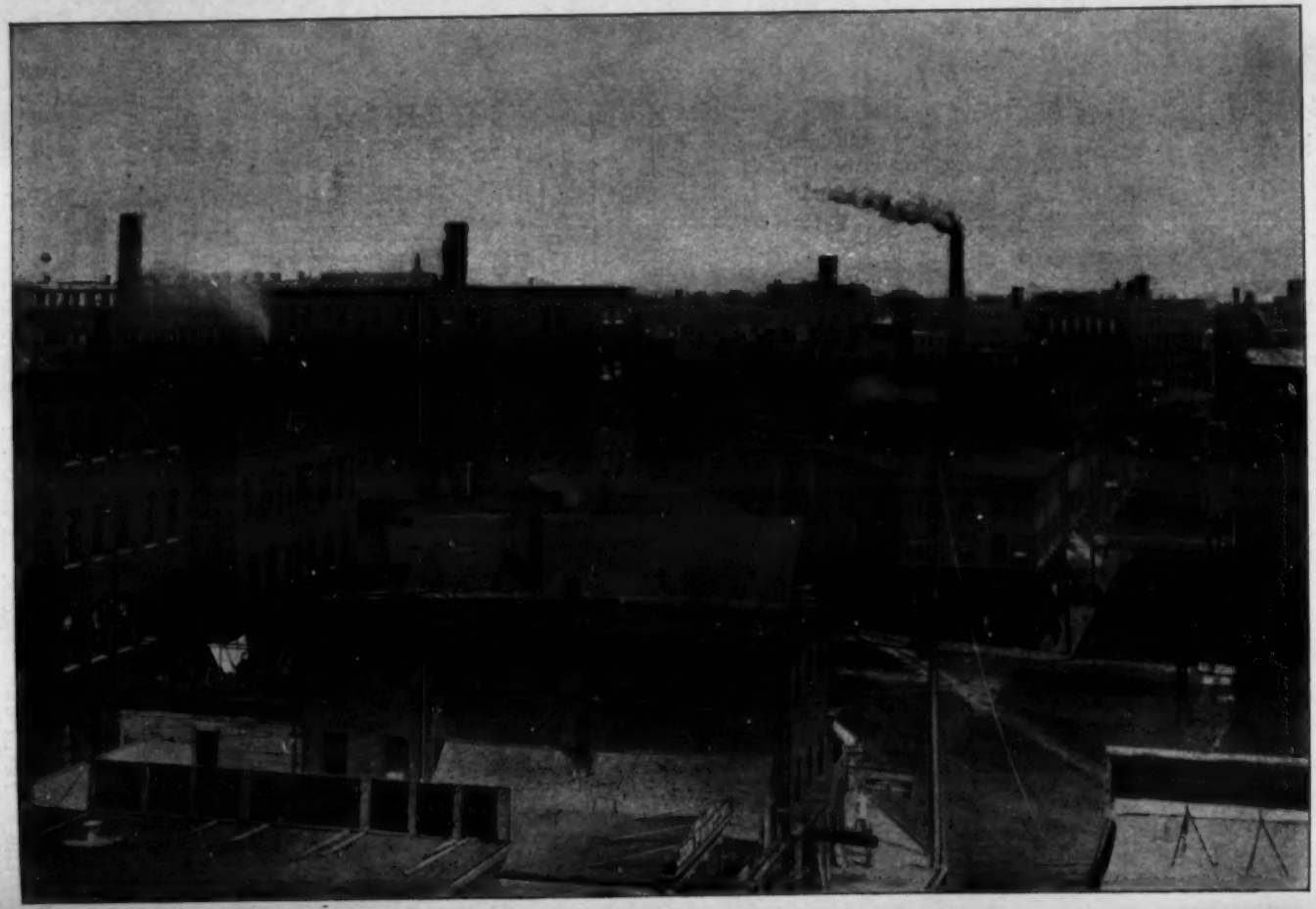


Fig. 14.—A Glimpse of the "City of Shoes."

and shoemaking industries has cheapened the products of the latter, one has only to compare the price of any kind of goods for a series of years. For illustration, take women's Polish grain shoes, men's boots and brogans. These are all cheap goods, and as the prices in the first place would have to be as low as possible great reductions would not be expected. Yet note:

Ladies Polish shoes per pair: 1865, $2.25; 1868, $1.62½; 1870, $1.37½; 1875, $1.12½; 1880, $0.95. Brogans: 1865, $1.75; 1870, $1.50; 1880, $1.30; 1885, $1.20; 1890, $1.05. Men's heavy boots, per dozen pairs, kip and double half soles in order: 1872, $38 and $25; 1880, $26 and $21.50; 1885, $26 and $20; 1890, $21 and $17.

In spite of all competition Massachusetts has retained its early grip upon the shoe industry, and within its factories are to be seen the art at its highest and its results at their best. In 1845, in that State, 45,877 hands made 20,896,312 pairs of boots and shoes, and in 1875 49,608 made 59,762,866 pairs—that is, an increase of less than one tenth in the manual force resulted in an output nearly three times as great. New Hampshire and Maine, however, have considerable interests in the shoe business, and factories are beginning to spring up in the West and the South. Unfortunately, the census figures for the last decade have not been completed; but the following table will tell the story for the thirty years between 1850 and 1880:

	1850.	1860.	1870.*	1880.
Whole number of establishments	11,305	12,487	† 3,151 23,428	† 1,959 17,972
Persons employed	105,254	123,029	91,702 135,889	111,152 133,819
Capital	$12,924,919	$23,358,527	$37,519,019 $48,994,366	$42,994,028 $50,995,144
Wages	$21,622,608	$30,938,920	$42,504,444 $51,972,712	$43,001,438 $54,358,301
Materials used	$23,848,374	$42,729,649	$80,502,718 $93,582,528	$102,442,442 $114,966,575
Value of product	$53,967,408	$91,891,498	$146,704,055 $181,644,090	$166,050,354 $196,920,481
Wages per employé	$205 48	$251 48	$463 50 $382 46	$387 21 $381 07

The increase in the number of establishments between 1860 and 1870 and the decrease between 1870 and 1880 mean no decline in the industry. This change results from the tendency toward consolidation and concentration. Improved machinery has enabled large producers to crowd their smaller competitors out of the business or to force them into combination. The same move-

* Currency.

† The first figures in these columns are special factory statistics. These were collected only in 1870 and 1880.

ment is manifest in other manufacturing industries, like cotton and woolen. The decade following the war was a period of enormous individual expansion, while that succeeding it was one of corporate extension. This fact appears in the marked increase in capital and productive capacity in union with a decrease in the number of separate factories. That the forthcoming census will show further evidences of this change seems certain from the reports that have been published from time to time during the past ten years by those familiar with the progress of the industry. This development, however, has not been at the expense of the operatives, as is shown by the increase in their earnings since the introduction of machinery. The gain has been more than a third, as indicated by the above table. In 1885 the Massachusetts Bureau of Statistics of Labor undertook an investigation of the net profits of the manufacturing industries of the State, and from returns received from 2,344 private boot and shoe manufacturing firms, employing 66,800 operatives, the average yearly earnings of the latter were $385.89; and from 22 corporations, employing 2,731 operatives, the average was $417.06. That would give for the 2,366 concerns annual average earnings of $401.47 for the operatives, considerably in excess of the country at large. The same investigation showed that in the cost of the production of boots and shoes 27·65 per cent was charged to labor and in that of leather 17·07 per cent went to it. This compares with 28·84 in cotton goods, 20·72 in woolen goods, and 27·18 in silk goods. On the side of the manufacturer these returns showed a net profit of 14·06 per cent on the capital invested in the boot and shoe industry against 8·13 per cent in leather, 0·65 in cotton goods, and 5·47 in woolen goods. The American shoe operatives as a body are thrifty and prosperous, and certainly much better paid than their fellow-craftsmen abroad. Skilled operatives in this country earn from $11 to $18 a week, while the same class in England obtain only $5.50 to $8.50, and in Germany $5 to $6.50. Mr. W. L. Terhune, of the Boot and Shoe Recorder, in an account of a trip among the shoe-factories of England, says that the skilled operatives at Northampton told him that they averaged only about $6 a week, so that the annual earnings for the best paid of them scarcely exceeded $300. With the extension, or rather the over-extension, of the business, and the consequent competition, there have come cuts in wages and strikes; but the same leaven of unrest prevails in the other old industries, and there is nothing peculiar about its manifestation, perhaps, except that the operatives and manufacturers in the shoe industry are both better organized than in other branches.

What the next decade has in store for the boot and shoe industry can be only a matter of speculation. At present the machines

for the several operations are distinct. Will some genius combine them into a single one? Will it be possible ever to throw into a hopper a side of leather and take out a finished shoe? Such a question appears absurd to-day. But what would our great-grandfathers have thought of the McKay or Goodyear stitchers?

BEGINNINGS IN BOTANY.

By BYRON D. HALSTED, Sc. D.,
PROFESSOR OF BOTANY IN RUTGERS COLLEGE, NEW JERSEY.

MUCH has been said, largely in a theoretical way, concerning the general question of university extension. Various experiments have been made, and by another year definite plans will be matured for the popular presentation of many of the subjects that come within the scope of the extension movement as now understood by those who have had the most to do with the scheme for the education of the masses.

The writer has recently finished a brief course in botany, and, as the method pursued differed in some features from any previously followed, there may be sufficient reason, in this, for presenting an outline of the ground covered and the ways and means employed for bringing the subject to the attention of a popular audience.

The course consisted of six meetings, and the average attendance was fifty. Each session extended over two hours, namely, from four until six in the afternoon of successive Fridays for six weeks in late spring. The first hour of each exercise was devoted to a lecture, and the following were the subjects considered: (1) The Seed, its Origin, Structure, and Uses; (2) the Stem and Root; (3) the Leaf, its Structure and Function; (4) the Flower, its Form and Use; (5) the Fruit—Kinds and Functions; (6) Ferns, Mosses, Algæ, and Fungi.

A full outline of these lectures was furnished each pupil in a sixteen-page syllabus, and the points covered were fully illustrated by means of *papier-maché* models of various sorts of plants, by numerous wall-charts, and, best of all, by a large number of living specimens.

The lecture served as an introduction to the class exercise which it immediately preceded. In this latter each pupil was furnished with a seat at a table and provided with specimens upon which to work. As before stated, the first lecture was upon seeds. This embraced the whole question of germination, and for a portion of the class-hour attention was given to the study of seedling plants, each pupil having specimens of young corn

and bean plants for comparison. These two seedlings, because representing the two great types of flowering plants, namely, the exogens and endogens, made it possible to illustrate the leading features of each by contrast. Sketches and descriptions of these were made during the hour by each pupil. Recognizing the fact that seeds come from flowers, and that the time for the course was short, a half-hour was spent in the study of a very simple flower, the spring lily (*Erythronium americanum*). For this purpose a blank was provided, shown in part in Fig. 1, and before the session was through the various parts of a blossom were learned. Similar blanks were given the pupil for home study, and, before leaving, each was handed a box containing five kinds of seeds—namely, corn, bean, flax, clover, and timothy—with directions for sowing in a box or flower-pot for individual home study. In addition to this the first twenty pages of Gray's Revised Lessons were assigned for study. The public library of the city was equipped with a full list of reference-books in botany at the beginning of the course.

*Student's Name*_____

1. Is the FLOWER—
   - Perfect?
   - Complete?
   - Regular?
   - Symmetrical?
2. Is the CALYX—
   - Gamosepalous?
   - Polysepalous?
   - Free?
   - Adherent?
3. Is the COROLLA—
   - Gamopetalous?
   - Polypetalous?
   - Free?
   - Adherent?
4. How many STAMENS?
   - Free.
   - Adherent.
     - Anthers.
       - Innate.
       - Adnate.
       - Versatile.
     - Filaments.
       - Shape.
       - Length.
5. How many PISTILS?
   - Free.
   - Adherent.
   - Stigma.
   - Style.
   - Ovary.
     - Cells.
     - Placentation.
     - Ovules.
       - Number.
       - Position.
   - Fruit.
   - Seed.
6. INFLORESCENCE.
7. LEAVES.
   - Arrangement.
   - Venation.
   - Shape.
   - Base.
   - Apex.
   - Margin.
   - Petiole.
   - Stipules.
8. STEM.
   - Exogenous.
   - Endogenous.
9. COMMON NAME.
10. SCIENTIFIC NAME.

FIG. 1.

The second lecture embraced a consideration of the stem and root. The chief differences between these two plant-members were pointed out and illustrated with specimens. Buds, as to their nature, structure, arrangement, etc., were dwelt upon, followed by many illustrations of various kinds of stems, such as tendrils, spines, and numerous forms of subterranean stems, like potato tubers, bulbs, and root-stocks of many plants. Various kinds of roots were shown, particular attention being paid to the functions of these underground portions, followed by an exposition of the way in which the soil constituents are taken up by plants.

The first half of the class exercise of the second day was occupied with a study of the buds of the horse-chestnut, in connection with more advanced specimens of the same species in which the buds have unfolded, and the scales, leaves, and flower-cluster were fully shown. After drawings were made of these, and a study of the corn-stem to illustrate the second type of stem (endogen), the remaining portion of the hour was occupied with work on two

flowers of the more simple types gathered from the fields and furnished in abundance. Specimens of these plants, with blanks to fill in connection with the study of them, were taken home by the pupils.

At this session a report of the daily observations of the seedling bean, corn, flax, clover, and grass was submitted, and this work in the home garden continued. Twigs were assigned for study during the coming week, including a potato tuber that had been planted by each pupil the week before.

In the third lecture the subject of leaves was considered as to parts, arrangement, types of framework (venation), simple and compound forms, and various peculiar kinds of leaves were shown, as pitchers, fly-catchers, etc. It was in this lecture that some of the physiological principles of vegetation were brought out, including the taking up of the soil-water, its passage to the leaves, and the manufacture there, under the influence of sunlight, of the various compounds, as sugar, starch, and oil, that may be afterward employed in various ways in the economy of the plant.

The microscopic structure of the pulp of the leaf was shown by diagrams, and an insight was given into the cellular formation of tissues and their combinations into tissue systems. A very large number of kinds of leaves freshly gathered were exhibited to illustrate the many terms concerning foliage used in the classification of plants. In size and shape these varied through all gradations, from the mere scales of the asparagus and conservatory "smilax" to those of the garden rhubarb; and of the compound sorts, from the barberry with a single leaflet to those of the columbine.

The class-hour was devoted to the study of three plants, the flowers of which illustrated as many widely separated types. Thus the wistaria gave large peculiar blossoms of the pulse family, and in this connection a *papier-maché* model of the pea was dissected before the class, thus fully illustrating the several parts, even to the coats and embryo of the forming seeds, by means of a separate model of an enlarged pea-pod.

In the fourth lecture the flower was considered, and, while the parts had been previously learned in class-work with specimens, the functions of the various organs were now explained by means of diagrams and specimens. The many ways in which the pollen of one flower is brought to the pistil of another were illustrated, and the fact that close fertilization is the exception and not the rule emphasized. The pupils were made familiar with the various forms of flower arrangement by seeing the living examples. Perhaps fifty kinds of plants in bloom were shown to illustrate not only inflorescence but the form and union of the several parts of individual flowers.

During the second hour attention was called to the analytical key as an aid in classifying plants, and the class as a whole was instructed by carrying three plants successively through the key to the species. At the same time blanks were filled which made a record of each student's results of inspection. Pupils were now ready to take the simpler plants and classify them at home, which was done to a large extent by some members of the class.

The fifth lecture was a treatment of the general subject of fruits. The subject was illustrated by means of a large list of fruits, freshly gathered from the field, supplemented with several sorts procured at the store. Various seed-vessels may be found in the spring that illustrate fully the methods of opening of the dry fruits for the scattering of seeds, and these were drawn upon at this seemingly unseasonable time for the study of fruits with excellent results. The methods of pressing and mounting plants were practically illustrated at the close of the hour, and a portion of a herbarium placed within reach for inspection.

During the class-hour fresh specimens were supplied, and each pupil worked independently in large part in determining the species. Particular attention was paid to fruits, and the twisting of the cranesbill awns, for example, was seen by all. The sensitiveness of the stamens of the barberry was likewise observed by the class during the hour.

For home work, besides the twenty pages in the text given for each lesson, ten questions were asked in the syllabus, the answers to which were handed in at the next meeting, along with the reports upon "Topics for Study," likewise given in the syllabus. Thus, under Fruits, two of the questions were "(4) In what particular does a strawberry differ from a rose fruit? (6) Of what advantage to a plant that its fruit is a highly colored berry?" Under "Topics for Study" one requirement was to "make drawings of a cross-section of an orange and an apple."

The sixth and last lecture of the course considered the flowerless plants, or those forms of vegetation which are propagated through spores and not by means of seeds.

While upon the ferns, several species in quantity were in the hands of the members of the class, and the method for classifying them gone through with while the descriptive terms necessary for this were being considered. Plates covered with fresh mosses, some sterile and others in fruit, were passed around, while the manner of spore-formation was illustrated by a large *papier-maché* model of the moss capsule, that was dissected before the class. Various groups of fungi were considered, some of the larger forms shown, as the toad-stools, shelf fungi, and the like, and several rusts were also exhibited. The lecture and the course closed with a consideration of the various groups of sea-weeds,

specimens of which were handed around the class. The leading books upon the several families of cryptogams were shown, especially those illustrating the subject by means of large plates.

It was announced in the syllabus that the examination for certificates would be held in the following autumn, and at the close of the last lecture a conference was held with the candidates, about twenty-five, and a short preliminary examination given them upon the matter contained in the syllabus. This portion of the class was instructed to make a careful study of the whole of Gray's Revised Lessons, and encouraged to collect specimens, study and classify them, and make a herbarium of at least fifty species to in part represent the work done in the field.

Thus in six exercises pupils were more than started in the study of plants, and there is no question that a groundwork was laid for an acquaintance with botany that should be one of constantly growing interest as the years succeed each other.

MICHAEL SERVETUS: REFORMER, PHYSIOLOGIST, AND MARTYR.

By CHARLES McRAE.

THE sixteenth century produced an unusually large number of famous biologists. To it belonged Andreas Vesalius, the incomparable anatomist, and his teachers, Sylvius and Winter of Andernach; Columbus of Cremona, to whom the discovery of the pulmonary circulation of the blood was for a century and a half ascribed; and Fallopius, Eustachius, Arantius, Fabricius of Aquapendente, and Cæsalpinus—men whose names have become familiar to every student of anatomy. Foremost, perhaps, among these illustrious workers stands the name of Michael Servetus, the physiologist and liberal thinker, who was burned to death as a heretic at Geneva in 1553, and whose life and tragic end have ever since excited the interest and sympathy of mankind.

Michael Servetus was born in Aragon or in Navarre about the year 1509. At an early age he entered the University of Saragossa, from which, in 1528, he was sent as a law student to the University of Toulouse. Here he may have read some of Luther's writings, for several of the latter were translated into Spanish soon after their publication. But whether he saw them or not, after staying two or three years at Toulouse he acquired certain views which were antagonistic to some of the generally received dogmas of the Church, and which influenced the whole of his subsequent life.

Quitting the university, he went—in what position it is un-

known—with a Franciscan friar named Quintana, who was confessor to the Emperor Charles V, to Bologna, to the coronation of that monarch. And here, in Italy, it is supposed that he met with opinions which strengthened his desire for liberty of thought, for about this time he thus expresses himself: "For my own part I neither agree nor disagree in every particular with either Catholic or Reformer. Both of them seem to me to have something of truth and something of error in their views; and, while each sees the other's shortcomings, neither sees his own. God, in his goodness, give us all to understand our errors, and incline us to put them away." . . .

Leaving Bologna, the emperor with his suite proceeded to Germany to hold the Diet of Augsburg. And here Servetus probably saw and spoke to some of the leading Reformers.

Soon after this, however, he quitted the service of Quintana, and we find him seeking the friendship of certain of the Reformers, Œcolampadius and Bucer. He must have had the power of winning friends, for Bucer, in a letter, speaks of him as his dear son, "*filius meus dilectus.*"

In 1531 Servetus published at Hagenau his first book, De Trinitatis Erroribus. This production of a young man only twenty-one or twenty-two years of age, crude as it was, excited remark from Luther and Melanchthon. In the Table-Talk of 1532 Luther refers to it as "a fearfully wicked book which had lately come out against the doctrine of the Holy Trinity. Visionaries like the writer do not seem to fancy that other folks as well as they may have had temptations on this subject. But the sting did not hold; I set the Word of God and the Holy Ghost against my thoughts and got free."

Melanchthon confesses he has read Servetus much. "I see him indeed sufficiently sharp and subtle in disputation, but I do not give him credit for much depth. He is possessed, as it seems to me, of confused imaginations, and his thoughts are not well matured on the subjects he discusses."

Œcolampadius wrote: "Our senate have forbidden the Spaniard's book to be sold here. They have asked my opinion of its merits, and I have said that as the writer does not acknowledge the co-eternity of the Son, I can in no wise approve of it as a whole, although it contains much else that is good."

Servetus now followed this with Two Dialogues on the Trinity, explanatory and additional to the former work. Thus he published two books against the principal dogma of the Church in less than two years, without hesitating to put his name on the title-page of both. He was very young, extremely zealous for his new opinion, and perhaps unacquainted with the principles of the Reformers. He may have thought that if they wrote freely

about the doctrine of Transubstantiation, why should he not inquire into the truth of the doctrine of the Trinity. But the reception afforded to his two works was of such a kind as to convince him that he had committed an imprudent act in allowing his name to appear as the author, and he accordingly changed his name and retired to Lyons. The name he now assumed, and by which he was always afterward known, was Michael Villeneuve, or Villanovanus, after the town of Villanueva, in Aragon, from which he probably came.

At Lyons he found work as a corrector for the press, at the publishing firm of the Brothers Trechsel, and he edited the Geography of Ptolemy. The description of Palestine which this book contained, although really an extract and not an original statement by Servetus, was quoted against him eighteen years afterward when he was tried for his life at Geneva. It concluded with these words: "Know, however, most worthy reader, that it is mere boasting and untruth when so much of excellence is ascribed to this land; the experience of merchants and others, travelers who have visited it, proving it to be inhospitable, barren, and destitute of all charm. Wherefore you may say that the land was *promised*, indeed, but is of *little promise* when spoken of in every-day terms."

The latter part of the following description of the Germans, which is given in this book, looks like an expression of Servetus's own opinion: "Hungary is commonly said to produce oxen, Bavaria swine, Franconia onions, turnips, and licorice, Swabia harlots, Bohemia heretics, Switzerland butchers, Westphalia cheats, and the whole country gluttons and drunkards. The Germans, however, are a religious people; not easily turned from opinions they have once espoused, and not readily persuaded to concord in matters of schism, every one valiantly and obstinately defending the heresy he has himself adopted."

While thus working at Lyons, Servetus formed the acquaintance of Doctor Campeggius, to whose influence it was perhaps due that he decided to take up the study of medicine. To carry out this determination he proceeded to Paris, and entered as a student at the university under Johannes Guinterus (Winter of Andernach) and Sylvius. Here he had as a fellow-student Andreas Vesalius, the famous anatomist, to whom, as well as to Servetus, their teacher Winter makes a laudatory reference some time afterward. Writing in the preface to his Anatomical Institutions, published in 1539, Winter informs his readers that he "had been effectually aided in the preparation of the work, first by Andreas Vesalius, a young man, by Hercules! singularly proficient in anatomy; and after him by Michael Villanovanus, distinguished by his literary acquirements of every kind, and

scarcely second to any in his knowledge of the teaching of Galen."

After taking his degree, Servetus lectured in Paris on geometry and astrology. The lectures on the latter subject involved him in a dispute with the university; and in March, 1538, we find him defending by counsel a suit that was brought against him by the medical faculty on account of these lectures. In 1537 he wrote a little book, Syruporum Universa ratio, the most popular, perhaps, of all his writings, containing six lectures on digestion, with one chapter—the fifth—devoted to the composition and use of sirups, or *tisanes*.

In June, 1538, he was at the University of Louvain studying theology and Hebrew; and in a letter to his father written from this place, he explains that he has left Paris, owing to the death of his master, but hopes to return soon. After practicing as a doctor for a short time at Charlieu, he continued his studies for part of 1540 at the University of Montpellier, where unusual facilities were at that time afforded to medical students.

At Paris, some years before, Servetus had made the acquaintance of Pierre Paumier, a man of learned tastes, who was now Archbishop of Vienne, in Dauphiny. At his invitation the Spaniard took up his residence at Vienne, and there appears to have lived in quiet seclusion from 1541 to 1553. His professional work was not too heavy to allow of his taking up literary pursuits also. He brought out a new edition of Ptolemy's Geography, and he annotated the Latin Bible of Pagnini. In his preface to the latter work he intimates what he considers to be the proper method of interpreting the prophetical books. He says that people who are ignorant of the affairs and customs of the Hebrews easily think the historical and literal sense of no importance; and in consequence of this they ridiculously follow a mystical interpretation everywhere. "Wherefore," he adds, "I would desire you again and again, Christian reader, to get the knowledge of the Hebrew in the first place, and, after that, diligently to apply yourself to the study of Jewish history, before you enter upon the reading of the prophets."

One of the gravest charges brought against Servetus by Calvin was that by such a method of interpretation "this impostor has dared to give such a wrong turn to the passages (contained in the fifty-third chapter of Isaiah) as to interpret them of Cyrus. So that whatever the prophet has with great perspicuity, and with the utmost force of expression, discoursed, this perfidious villain has blotted out (*delevit hic perfidus nebulo*)."

Here it may be remarked that while no one would pretend that Servetus was a biblical critic and expositor, yet his method

of looking first for the historical and literal meaning is the method of the modern school of scriptural exegesis.

The book which immediately brought about the imprisonment and death of Servetus was called Christianismi Restitutio—the Restoration of Christianity. It contained, besides a series of chapters setting forth the various theological tenets of the author, thirty letters addressed to Calvin. The views of the writer, although fantastical, and in many instances unintelligible, often exhibit a broad and tolerant spirit, and always breathe intense earnestness. He appears to have felt himself impelled to propagate his opinions on these theological matters, and to have come to regard this as his mission in life, which must be fulfilled at any risk. So much, at least, is clear from the invocation to Christ, with which he closes his introduction. "Thou hast taught us that the light is not to be hidden, so woe to me unless I evangelize."* He seems even to have thought that he had his vocation shadowed out to him in his name. The angel Michael led the embattled hosts of heaven to war against the dragon; and he, Michael Servetus, had been chosen to lead the angels on earth against Antichrist!

This book is now one of the rarest in the world. Two copies only are known to be extant—one at Paris and another at Vienna. A copy of the latter, printed in 1790, is in the British Museum.

In this work, while writing on the Trinity (Book V), Servetus introduces certain physiological statements in order to illustrate some of his theological speculations. The passage, although lost to the world for nearly a century and a half, has long ago become famous. It was first brought to light in Wotton's Reflections upon Ancient and Modern Learning, published in London in 1694. It proves that the knowledge which Servetus possessed of the way by which the blood passed from the right to the left side of the heart was in advance of his time, and a step beyond that reached by Galen. The latter had taught that the blood, for the most part, passed through the septum, from one side of the heart to the other. Servetus wrote: "This communication" (i. e., from the right ventricle of the heart to the left) "does not take place through the septum, partition, or midwall of the heart, as commonly believed, but by another admirable contrivance, the blood being transmitted from the pulmonary artery to the pulmonary vein, by a lengthened passage through the lungs, in the course of which it is elaborated and becomes of a crimson color. Mingled with the inspired air in this passage, and freed from fuliginous

* "Lucernam non esse abscondendam, tu nos docuisti, ut væ mihi sit nisi evangelizem." Christ. Restit., p. 2.

vapors by the act of expiration, the mixture being now complete in every respect, and the blood become fit dwelling-place of the vital spirit, it is finally attracted by the diastole, and reaches the left ventricle of the heart." He then goes on to give as proofs of the accuracy of his statements (1) the various conjunctions and communications of the pulmonary artery and pulmonary vein in the lungs, and (2) the great size of the pulmonary artery, and the great quantity of blood passing through it; both being much larger than would be required for the mere nutrition of the lungs. He concludes that the septum, seeing that it is without vessels and special properties, is not fitted to permit the communication in question, "although," he adds, "it may be that some transudation takes place through it."* This unfortunate qualification of what he has so distinctly affirmed just before—namely, that the communication does *not* take place through the septum—is not very intelligible; for if he believed the blood to soak through the septum, his theory differs but little from that of Galen, and yet Servetus calls attention to the fact that what he is declaring was unknown to Galen.†

Prof. Huxley ‡ points out that Servetus quotes neither observation nor experiment in favor of the imperviousness of the septum. But neither does Realdus Columbus,# who correctly described the lesser circulation in 1559, and to whom the credit of the discovery was very early ascribed. ‖ It is to be remembered that the work in which Servetus introduces his discovery is not a treatise on physiology, and that the whole passage being brought in by way of illustration is not fully treated.

It is clear, however, that Servetus held (1) that the blood in a great stream passes from the right ventricle of the heart to the lungs; (2) that in the lungs, and not in the left ventricle, it is purified; and (3) that from the lungs it passes by the pulmonary vein to the left ventricle of the heart and thence into the arteries.

From these statements of fact Servetus quickly passes to metaphysical speculations. He has before said: "There are three sorts of spirits in the human body—namely, natural, vital, and animal—which are not in reality three, but two distinct spirits only; the arteries communicating by *anastomoses*, the vital spirit to the veins, in which it is called natural. The first spirit then is the blood, whose seat is in the liver, and in the veins of the body; the second is the vital spirit, whose seat is the heart and arteries; the

* "Licet aliquid resudare possit." Christ. Restit., p. 171.

† Christ. Restit., p. 171.

‡ Fortnightly Review, February, 1878.

De Re Anatomica Realdi Columbi Cremonensis, 1559, p. 177.

‖ Opera Chirurgica Ambrosii Paræi, 1594, p. 116.

third is the animal spirit, whose seat is in the brain and nerves." Now, he goes on to suppose that the blood, having received in its passage through the lungs the breath of life, is sent by the left ventricle into the arteries. The purest part ascends to the base of the brain, where it is more refined and changed from the vital to the animal spirit, and acts upon the mass of the brain, which is incapable of reasoning without its stimulus. From this, and much more which is unintelligible, it appears plain that Servetus had read the schoolmen, and was imbued with their methods of reasoning.

To get published a book filled, as the Christianismi Restitutio was, with theological opinions repugnant alike to Catholics and Reformers, was no easy task. And in effecting his purpose Servetus exercised great caution and ingenuity. At Vienne, where he had lived for twelve years, was a publisher named Arnoullet, whom, with the printer Geroult, Servetus took into his confidence. He engaged not only to pay the whole expenses, but also to add a gratuity of a hundred crowns. It was arranged that the printing should not be carried on at the ordinary place of business, but that a small house at some distance should be used for the purpose. The printing was commenced on St. Michael's day, and in three or four months one thousand copies of the book were ready.

No name appeared on the title-page, but at the end of the book immediately over the date the initials "M. S. V." were placed, and at page 199, at the commencement of the dialogue between Michael and Petrus, the latter is made to say: "Here he is; Servetus is here, of whom I was speaking." The reference made in the preface to former works on the same subject, and the introduction of Michael and Peter as interlocutors, just as had been done in the Dialogue on the Trinity twenty years before, rendered it easy to establish that Michael Servetus and Michael Villeneuve were one and the same man.

The whole stock of books, when ready, was made up into bales of one hundred each, and sent away, the greater part to Lyons, to the care of a type-founder named Pierre Merrin, who believed that the packets contained nothing but blank paper. It was probably intended to forward them, as soon as opportunity offered, to Genoa and Venice.

Meanwhile, unknown to Servetus, a copy of the work, and a letter giving particulars of the printing of it, were dispatched to Calvin at Geneva, probably by some one at Lyons, who had friends at Vienne, and who was in the confidence of both Servetus and Calvin. Armed with this evidence against the Spaniard, Calvin caused a letter to be written to Vienne by a young man named William Trie, denouncing Servetus, and inclosing

the first few sheets of the Christianismi Restitutio. By a subsequent mail he sent by the same man about twenty letters, which he had received from time to time from Servetus. On this the latter was arrested, and conveyed to prison on the pretense of being required to see some sick prisoner. He was immediately examined closely as to his early history and the meaning of some of his writings. Taken by surprise, as he was, he appears to have prevaricated, and tried to hide his identity with the author of De Trinitatis Erroribus, by pretending that in his letters with Calvin he had personated Servetus merely for the purpose of discussion. Facts looked very black against him, but he probably had very powerful friends, and it may have been with the connivance of some of them that two days afterward he made his escape from prison. The whole plot was soon ferreted out by Matthew Ory, the Inquisitor; the books were seized, and Servetus was condemned "in a pecuniary mulct of a thousand livres, to be paid to the King of Dauphiny"; and the sentence went on, "as soon as he shall be taken he shall be drawn in a dung-cart, with his books, on the market-day and hour, from the gate of the Royal Palace, through the streets and accustomed places, to the common hall of the present city, and from thence to the place called Charneve, and there he shall be burnt alive, with a slow fire, until his body shall be reduced to ashes. In the mean time the present sentence shall be executed in effigy, with which the said books shall be burnt."

This sentence was duly carried out on June 17, 1553, the effigy and five bales of books being burned to ashes.

Of such action as Calvin's in thus betraying what had been communicated to him in the confidence of a letter, into the hands of a professed enemy of both, Erasmus expresses himself as follows: "You are not ignorant how abhorrent, I do not say from virtue, but entirely from all humanity, it is to betray the secrets of friendship; forasmuch as we detest even those who, after a breach of friendship, shall divulge what was said in confidence before; nor can those of a generous disposition suffer themselves to betray that which they know, from the confidence of ancient friendship, will expose one to the resentment of his greatest enemies."

Having escaped from Vienne, Servetus probably remained in hiding first at Lyons. But the discovery of the whole matter, and his subsequent condemnation, made it imperative that he should get out of France. Many Spaniards were settled at Naples, and thither he now seems to have determined to push his way. For some reason or other, probably because he expected more leniency from Reformers than from Catholics, he preferred to go through Switzerland rather than Piedmont. He reached Geneva, and

lodged at the Rose Inn, intending to go by boat to Lausanne on his way to Zurich. Calvin, however, learned that he was in the town, and he immediately informed the first syndic, and caused him to be apprehended; and here he was kept while proceedings were being taken against him, from August 14th to October 27th.

The people of Geneva, in the year 1553, were, and had been for several years, divided into two hostile parties, struggling desperately with each other for the supremacy. The austerity and tyranny of Calvin had aroused against him many opponents, and it seemed now as if these were on the point of attaining the ends for which they had been so long striving. Calvin's earliest attempts at ruling the Genevese had soon met with failure. He had first settled in Geneva in 1536, but so unpopular had he become in two years that he and his colleague, Farel, were formally banished from the city. Passing from Basle to Strasburg, he had taken up his residence in the latter city as Professor of Theology. But after two years, in response to a deputation which came and besought his return to Geneva, he consented to go back, and in September, 1541, he took up his old position under greater advantages than before. He then laid before the Council the draft of his ordinances respecting church discipline, and these were at once accepted. A consistory was formed, composed for the most part of clergymen, with the addition of a few laymen, "to watch over the support of the pure doctrine and of morals." The tribunal called everybody, without exception, to account for his slightest words or actions, and referred cases, where ecclesiastical censure was not sufficient, to the Council. Thus Calvin had made himself director of the conduct as well as of the opinion of the Genevese. His spirit governed exclusively in the Council as in the Consistory, and no one could hope to succeed who set himself in opposition to Calvin.

Twelve years of such bondage, however, had not been borne by the Genevese without indication of discontent and dissatisfaction. The Council declared that clergymen could no longer be admitted to its meetings, although they had not been previously excluded; men who were under the consistorial ban for some infringement of discipline were chosen as councilors, and even open hostility was shown to Calvin, who wrote: "The accumulated rancor of their hearts breaks out from time to time; so that when I show myself in the street, the curs are hounded on me."

To the great misfortune of Servetus it was at such a time as this that he arrived in Geneva. His case became the subject of dispute over which the two factions fought one of their bitterest struggles; and although Calvin had declared some years before that if the Spaniard ever came to that city he should not escape

with his life,* yet probably the relentless Reformer was now bent on his destruction quite as much by a desire to defeat the opposite party as by the personal hatred he had for Servetus.

The nominal prosecutor of Servetus was a creature of Calvin's —a certain Nicolas de la Fontaine—who, in accordance with the law, had not only to bind himself over to continue the suit to a conclusion, but also to go to prison with the accused man, and, in compliance with the requirements of the *lex talionis*, to engage, in case his charges were not made good, to undergo the penalty that would have fallen on the accused had they been established.

Thirty-eight articles of impeachment were advanced against Servetus. One of these was that he had defamed Mr. Calvin and the doctrine that he preached. To this Servetus replied that he had had abusive language from Calvin, and that he had only answered in the same terms. La Fontaine produced Ptolemy's Geography, the annotated Bible, the Christianismi Restitutio, and certain MS. letters, and Servetus admitted that he was the author of all. It having been considered now that sufficient evidence had been furnished to warrant prosecution by the attorney-general, the court relieved La Fontaine of all charge, damage, and interest in the matter, and Servetus was committed for trial.

At the trial, passages from Ptolemy's Geography as to the character of Palestine were adduced as proofs of the heretical opinions of the prisoner, and when the latter added that the notes contained nothing harmful, or that was not true, Calvin himself warmly interposed. And writing afterward about the event, he says: "When Servetus stood so plainly convicted of this his impiety he had nothing to allege in his vindication. The filthy cur, laying aside all shame, asserted in one word that there was no harm in it."

The annotations of the Pagnini Bible were produced again, and Servetus was examined as to his method of interpreting prophetical passages, and then the meaning of certain extracts from the Christianismi Restitutio was inquired into, and a letter from Servetus, written about six years before to Abel Pepin, a preacher at Geneva, was put in. It contained two remarkable passages: "It is perhaps far from agreeable to you that I should concern myself with Michael's war in the Apocalypse, or that I should desire to bring you into the strife. But do so much as consider that passage narrowly, and you will soon perceive who the men were to be who would engage in that quarrel, namely, such as were resolved to expose their lives to death for the blood and the testimony of Jesus Christ. . . . That I must die for the cause I have espoused I certainly know; but I am not at all cast down

* In a letter from Calvin to Farel, dated Ides of February, 1546. Now in Paris Library.

on that account, since by that I shall be a disciple made like to his master."

Some days afterward Calvin came into court attended by all the ministers of Geneva, and undertook to prove that the teaching of the early fathers of the Church was opposed to that of Servetus. After Calvin and the prisoner had had a long dispute as to the meaning of the word *persona*, the court adjourned, but before doing so the judges gave permission for Servetus to be provided, at his own cost, with such books as he needed, which could be obtained in Geneva or Lyons. Some paper and ink, with which the prisoner was now for the first time furnished, enabled him to send in a petition on the following day. In this he pointed out that the prosecution, as a criminal, of a man on account of the views he held on doctrine was contrary to the Scriptures and to the ancient Church; and he begged that, as he was a foreigner, wholly unacquainted with the customs of the country, and of how he should proceed, he might be allowed an advocate. But to this very reasonable request, although subsequently repeated more than once, the judges did not accede.

The Syndics and Council of Geneva now addressed a letter to the authorities of Vienne, asking that the documents connected with the trial of Michael Villeneuve might be sent to them; and, three days after, they received a letter saying that these documents could not be forwarded, but that, if the prisoner were delivered over to them, the sentence already passed on him would be carried into effect. Servetus was hereupon asked if he preferred remaining in the hands of the Council or to be sent back to Vienne. Knowing full well that a cruel death most certainly awaited him in France, and hoping that no such punishment was in store for him here, he fell on his knees and besought the Council to do what they would with him, but in no case to send him back to Vienne.

The trial was accordingly continued.

Meanwhile, Servetus lay in one of the foul cells set apart for criminals of the lowest class, and we find him writing in a petition, dated September 15th: "Calvin is resolved that I should rot in a prison to please him. I am eaten up with lice. My hose are worn to pieces and I have no change, nor another doublet, and only one shirt, and that in tatters."

Another petition, dated a week later, ends with the words: "Wherefore, my lords, I desire that my false accuser should be punished *pœna talionis*, and confined to prison as I am, till he or I be condemned to death or to some other punishment. I am willing to die if he is not convicted both of this and other things which I shall lay to his charge. I beg of you, my lords, to do me justice. Justice, my lords, justice!"

Finally, on October 10th, comes his last appeal: "It is now three weeks since I desired to have a hearing, but could not obtain it. I beseech you, for the love of Jesus Christ, not to deny me what you would not deny a Turk, when I beg you to do me justice. I have several things to tell you that are very important and necessary. As to what you may have ordered to be done for me in the way of cleanliness, I have to inform you that nothing has been done, and that I am in a more miserable condition than ever. In addition to which, I suffer terribly from the cold and from colic, and my rupture, which causes me miseries of other kinds that I should feel shame in writing about more particularly. It is very cruel that I am neither allowed to speak nor to have my pressing wants supplied. For the love of God, my lords, either in pity or in duty, give some orders in my behalf."

During this time a letter was sent by the Council of Geneva to the different Swiss churches, asking for an expression of opinion on the case of Servetus. The answers came back in due course, and the Spaniard was declared to be an intolerable monster of impiety, and to have revived the wicked errors "with which Satan did formerly disturb the Church." The Church of Zurich was more vehement than the rest in exhorting the magistrates to deal severely with him.

On the morning of October 27th, Servetus was summoned "to learn the pleasure of my lords the Councilors and Justices of Geneva," and before the porch of the Hôtel de Ville he heard his condemnation: "To be burned alive, along with thy books, printed as well as written with thy hand, until thy body be reduced to ashes. So shall thy days end, and thou be made an example to others who would do as thou hast done."

The sentence was immediately carried into execution. In a few hours Calvin's most subtle disputant had forever ceased to trouble him, and the world was the poorer by one loving, faithful spirit.—*The Gentleman's Magazine.*

THE two main things required in anthropological study, said the Rev. Lorimer Fison, sectional president in the Australasian Association, are a patient continuance in collecting facts and the faculty of seeing in them what is seen by the natives themselves. But the natural tendency to form a theory as soon as a fact is seized, and looking at facts from the mental point of view of civilized man, may lead investigators into fatal mistakes. The best way to gain information is to live with the natives, learn their language, and get their confidence, or get information from the men living among them. References to aborigines, their manners and customs, in books might be collected and classified by many readers (as has been done in Spencer's Descriptive Sociology), and thus facilitate investigation. The speaker dwelt on the magnificent and all but untrodden field afforded by British New Guinea and its outlying groups of islands.

THE ROYAL SOCIETY; OR, SCIENTIFIC VISIONARIES OF THE SEVENTEENTH CENTURY.

By MARY DAVIES STEELE.

DURING the English Commonwealth period two little companies of natural philosophers were in the habit of meeting for study and experiments—one in London, and the other at the lodgings of Dr. Wilkins, warden of Wadham College, Oxford. At a later day these small clubs of *virtuosi*, as the scientists of that age were called, were united, and the society held all its sessions in London, at a tavern or private house; and when finally it attained such dimensions that a large room was necessary, it established itself in the parlor of Gresham College. It was originally called the Philosophic Assembly; but when, soon after the restoration of Charles II, Evelyn, in his dedicatory epistle, prefixed to Naudé's Treatise on Libraries, spoke of the Philosophic Assembly as the Royal Society, the name was immediately adopted by the members, with a vote of thanks to him for suggesting it. Charles was gratified, and declared himself their founder, giving them, as Evelyn records, August 21, 1662, "the armes of England, to be borne in a canton in our armes; and sent us a mace of silver gilt of the same fashion and bigness as those carried before his Majesty, to be borne before our president on meeting days." Evelyn, besides writing several books, at the request of the society, procured for it from the Howard family the noble Arundelian Library, adding, on one of his birthdays, his table of the lungs, liver, veins, and arteries; the first chart of the kind that was ever made. A rare print, designed by Evelyn, probably as a frontispiece to Spratt's History of the Royal Society, and beautifully engraved by Hollar, represents Lord Bacon as the founder of the society; for, as Disraeli says, he "planned the ideal institution in his philosophical romance of the New Atlantis." The picture contains fine portraits of Charles II, patron of the society; Lord Brouncker, its first president, and Lord Bacon, its founder, inscribed *Artium instaurator*. The library, statutes, journals, and mace of the Royal Society, and numerous philosophical instruments are represented in the engraving.

One peculiarity of the association was that men of all nations, religions, and professions were admitted to membership; for, as their historian, Bishop Spratt, said, they did not wish "to lay the foundations of an English, Scotch, Irish, Popish, or Protestant philosophy, but a philosophy of mankind." When the Society for Promoting Christian Knowledge desired to hold its meetings in the Royal Society's rooms, Sir Isaac Newton made the follow-

ing protest against their admission: "It is a fundamental rule of the society not to meddle with religion; and the reason is that we may give no occasion to religious bodies to meddle with us"; nor did the Fellows wish to "dissatisfy those of other religious bodies" who did not share the views of the Christian Knowledge Association. In the early days of the Philosophic Club, when only a few intimate friends belonged to it, Robert Boyle, on account of its smallness and lack of influence, often sportively called it the Invisible College—a name which, when this learned junto had become large and important, was recalled with terror by the enemies of the association, whether Aristotelians or religious bigots, who alike considered "the new experimental philosophy subversive of the Christian faith." The newly invented telescope and microscope were regarded by others besides ignorant fanatics with hatred and dread, as "atheistical inventions which perverted our sight, and made everything appear in a new and false light."

The opponents of the Royal Society asserted that the principal object that its supporters had in view was the extinction of universities, which were the strongholds of scholasticism and theology. Yet this association was one of the chief interests in the lives of many of the most devout and scholarly men of the seventeenth century. "Our holy religion" held the first place in their hearts, though they considered the "new philosophy" second in importance to Christianity. The imaginations and plans of the society were magnificent, but they were never carried out. The Fellows were fond of talking of their "universal correspondence," which, in the near future, would keep their ten secretaries —who, however, were never elected, though the constitution provided for them—hard at work; and they loved to throw an air of secrecy over their deliberations. These harmless vaunts and concealments added to the panic which the *virtuosi* excited in people who were ever dreading the establishment, openly or by the treachery of the Jesuits, of popery and arbitrary power, and led to the most unfounded suspicions and accusations.

One of the most injurious things said against the society was that its members were of the school of the Italian Campanella, who, it was *claimed*, wished to identify church and state throughout the world, and bring all nations under the power of a single tyrannical ruler, and to that end would divert men from theology and politics by occupying them with experimental philosophy. Campanella's universal king, as soon as by trickery or by some unaccountable and unexplained means he had firmly seated himself on his throne, would, it was asserted, carry out the dearest object of the philosopher, and substitute everywhere the ancient pagan philosophic for the modern Christian sects. Probably

Campanella and the more intelligent F. R. S. would alike, instead of advocating despotism in any shape, have asserted that if men were allowed to experiment, analyze, dissect, and philosophize "with the utmost freedom, the despotism of religion and politics would dissolve away in the weakness of its quiescent state." The truth is, the scholastics who opposed the experimental philosophy considered novelty of speculation, without regard to character or tendency, as heresy and treason. Perhaps Evelyn inadvertently raised this specter of Campanellaism. Naudé—whose book on libraries he translated for the Royal Society—was not only a skeptic and an advocate of absolute monarchy, but he was a warm friend and defender of Campanella, whose religious and political views are not very clearly defined.

Spratt, in his History of the Royal Society, eulogized Charles II for his interest in science; but Stubbes, his opponent, perhaps not wholly unmindful of the ignorant popular prejudice against Campanella, retorted that the natural philosophers were likely to *demoralize* the king (was anybody capable of that!), for "never prince acquired the name of great and good by any knickknacks, but by actions of political wisdom, courage, and justice."

It seems strange, when reading the literary and scientific history of the seventeenth century, to find Sir William Temple among the scoffers at the *virtuosi*. Personal dislike of some of the founders of the Royal Society was, no doubt, the reason *in part* of his opposition to experimentalists. He fancied the Fellows a "set of Sir Nicholas Gimcracks," and, with the wise men of Gotham probably in his thoughts, "contemptuously called them, from the place of their first meeting, 'men of Gresham.'"

In a letter to Cowley, urging the poet to write his poem in praise of the society—an ode described by Macaulay as "weighty in thought and resplendent in wit"—Evelyn indignantly exclaims: "There be those who aske, What have the Royal Society done? Where their colledge? I neede not instruct you how to answer or confound these persons, who are able to make even these informe Blocks and Stones daunce into order, and charme them into better sense. Or if their insolence presse, you are capable to shew how they [the F. R. S.] have layd solid foundations to perfect all noble Arts, and reforme all imperfect sciences. It requires an History to recite onely the Arts, the Inventions, and Phaenomena already absolved, improved or opened. In a word, our Registers have outdone Pliny, Porta, and Alexis, and all the Experimentalists, nay, the great Verulam himselfe, and have made a nobler and more faithfull Collection of real seacrets, usefull and instructive than has hitherto been shewn. Sir, we have a Library, a Repository, and an assembly of as worthy and greate Persons as the World has any; and yet we are sometimes the

subject of Satyr and the songs of Drunkards. We have a king to our founder and yet want a Macaenas; and above all a Spirit like yours to raise up Benefactors and to compell them to thinke the Designe of the Royall Society as worthy of their reguards and as capable to embalme their names, as the most heroic enterprise, or anything Antiquity has celebrated; and I am even amaz'd at the wretchednesse of this Age that acknowledges it no more. But the Devil, who was ever an enemy to Truth and to such as discover his praestigious effects, will never suffer the promotion of a designe so destructive to his dominion, which is to fill the world with imposture and keep it in Ignorance, without the utmost of his malice and contradiction. But you have numbers and charms that can binde even these spirits of darkenesse, and render their instruments obsequious; and we know you have a divine Hyme for us; the luster of the Royall Society calls for an Ode from the best of Poets upon the noblest Argument. To conclude, you have a field to celebrate the Greate and the Good, who either do or should favour the most august and worthy designe that ever was set on foot in the world; and those who are our real Patrons and Friends you can eternize, those who are not you can conciliate and inspire to do gallant things."

Evelyn's indignant defense of his beloved association is not surprising when we read the abuse the F. R. S. received from some of the most talented writers of the seventeenth century. The witty Dr. South said that the members of the Royal Society "could admire nothing but fleas, lice, and themselves." Hobbes, the philosopher of Malmesbury, considered them so many laborers, apothecaries, gardeners, and mechanics, who "might now all put in for and get the prize." Cross, Vicar of Chew, wrote ribald pamphlets and ballads, which he got sung about the streets, against the new philosophy. Stubbes, a man of perverted genius, accused the F. R. S. of atheism and treason, and they greatly feared his formidable series of attacks. Dr. King burlesqued their published volumes of Transactions, and ridiculed alike their grammar, style, and the inventions and discoveries they described. Wotton, who was a less sensitive F. R. S. than Evelyn, treats King, in his Reflections upon Ancient and Modern Learning, with "great good humor." He says: "A man is got but a very little way [in philosophy] that is concerned as often as such a merry gentleman as Dr. King shall think fit to make himself sport." Sir John Hill published a quarto volume of satire in the form in which the Transactions of the society were issued, and other books against the Fellows. But he did them good, for his parodies and ridicule taught them to be more cautious in the selection of papers for their printed reports.

In his preface to his Sylva the usually amiable Evelyn scolds at

a rate we should have thought impossible to him, at "the ignorant and comical buffoons who, with an insolence suitable to their understanding, are still [as he repeats] crying out, 'What have the society done?'" And he prophesies that the society "will survive the triumphs of the proudest conquerors; since when all their pomp and noise is ended, they [the F. R. S.] are those little things in black, whom now in scorn they term philosophers and fops, to whom they must be obliged for making their names outlast the pyramids, whose founders are as unknown as the heads of the Nile."

Unfortunately, though Evelyn's claim for the society was substantially correct, the *virtuosi* laid themselves open to ridicule by their many trifling, useless, and ludicrous questions, researches, and experiments, and much of their labor was wasted, and its results are now forgotten. The great Mr. Boyle is represented as mortified by the absurd investigations of trivial subjects in which some of his colleagues engaged, and as on one occasion tendering to a friend, with blushing and confusion at the simplicity of the society, their paper "giving instructions for inquiries." That "pleasant rascal," the witty Charles II, whom Evelyn could hardly have numbered among the scorners whom he described as "magnificent fops, whose talents reach but to the adjusting of their perukes," set the example of making fun of the Fellows on the very day that he constituted them a society. He dined with them on this occasion, as he did afterward; when he was not present they feasted on venison sent them by his Majesty. Toward the close of this first meeting, after expressing his satisfaction at being the only King of England who had founded a scientific society, he added, with that "peculiar gravity of countenance" which he assumed when preparing to mystify or hoax his companions with some witty but apparently grave and sincere remark or question, that he had no doubt the learned men before him could solve a problem that had long puzzled him. This was the question: Suppose two pails of water of the same weight were placed in two different but equally balanced scales, and that two live bream were put in either of the pails, why would not the pail to which the fish were added weigh more than the one to which no addition had been made? The Fellows were eager to satisfy the king's curiosity; but everybody gave a different answer. "One at length offered so ridiculous a solution that another of the members could not refrain from a loud laugh; when the king, turning to him, insisted that he should give his sentiments as well as the rest. This he did without hesitation, and told his Majesty, in plain terms, that he denied the fact! On which the king in high mirth exclaimed: 'Odds fish, brother, you are in the right.' The jest was not ill designed. The story was often use-

ful to cool the enthusiasm of the scientific visionary, who is apt often to account for what never has existed."

The king could, however, discuss soberly the topics beloved by the F. R. S., who had many a long scientific talk with him. He tried experiments himself, and Pepys speaks of going down at Whitehall "into the king's little elaboratory under his closet; a pretty place; and there saw a great many chymical glasses and things but understood none of them." Pepys was accompanied by his fellow-members, Lord Brouncker and Sir R. Murray. Under date of May 3, 1661, Evelyn writes: "This evening I was with my Lord Brouncker, Sir Robert Murray, Sir Pa. Neill, Monsieur Zulichem, and Mr. Bull (all of them of our society and excellent mathematicians) to show his Majesty, who was present, Saturn's annulus very neere eclipsed by the moon; also Jupiter and satelites, thro' his Majesty's great telescope, drawing 35 foote; on which were divers discourses." Another day Evelyn accompanied Charles "to Mons. Febure, his chymist (and who had formerly been my master in Paris), to see his accurate preparation for the composing Sir Walter Raleigh's rare cordial; he made a learned discourse before his Majesty in French on each ingredient." Another scientist of high rank was Prince Rupert, who with his own hands (which the jeering courtiers said too often bore the stains of the laboratory) taught Evelyn to engrave mezzotinto, and whom Evelyn introduced to the Royal Society, where, in spite of smoke-begrimed linen and fingers stained with acids, the soldier chemist was warmly welcomed as an agreeable companion and scientific brother. The well-known "Prince Rupert's drops" may be numbered among the scientific toys invented in this age.

Pepys gives an amusing account of an encounter between Charles II and the celebrated scholar, wit, and inventor, Sir William Petty. "Thence to Whitehall," he says, "where in the duke's chamber the king come and stay'd an hour or two, laughing at Sir William Petty, who was there about his boat (one of his inventions); and at Gresham College in general; at which poor Petty was, I perceived, at some loss; but did argue discretely, and bear the unreasonable follies of the king's objections and other bystanders with great discretion, and offered to take odds against the king's best boats; but the king would not lay, but cried him down with words only. Gresham College he mightly laughed at for spending time only in weighing ayre and doing nothing else since they sat."

Some time before this Evelyn wrote: "I went with that excellent person and philosopher, Sir Robert Murray, to visit Mr. Boyle. At Chelsy I saw divers effects of the Eolipile for weighing aire!" Boyle was the discoverer of "the law of the air's elasticity."

Pepys, no doubt, while the king teased and jeered at Sir William Petty, was indignantly recalling the society's many fine experiments with colors, fire, loadstones, microscopes, the air-pump, thermometer, liquors, musical sounds, vibrations of the air, blood injected into a dog to prove Harvey's theory of circulation, and "one that did turn a piece of roasted mutton into pure blood, which was very rare"; and another, when the blood of a sheep was transfused into a man.

He would have liked to remind his Majesty of the plans for planting the royal forests with oaks and other trees; abating London smoke, and making artificial fuel, which had emanated from the society; of how they had promoted new physiological, surgical, medical, botanical, chemical, physical, astronomical, agricultural, horticultural, and sanitary methods and discoveries; patronized art. literature, architecture, and mechanical inventions, and were doing all in their power to "disperse," as Macaulay said of them, "the phantoms which had haunted the world for ages, and destroy the belief in witchcraft, astrology, and alchemy."

Yet, alas! Charles might have retorted that many of their leaders were either seeking the philosopher's stone and the elixir of life, endeavoring to fly in the air, to collect the feathers of the wing of a phœnix, or catch "the disjointed syllables of an old doting astrologer." The contents of their museums were often no more valuable than the toys in the baby-house, and amusing rather than useful or really curious. Yet with these playthings they expected to work wonders in science.

The distinguished Sir Samuel Morland, who was reputed to have invented the steam-engine, the speaking-trumpet, drum capstans for weighing heavy anchors, arithmetical wheels, quench-fires, a new kind of harp, valuable bridges, a machine for throwing water to a great height, and other useful things, prided himself on his coach, which contained a kitchen with a fireplace, pots, frying-pans, and a machine for roasting meat by clock-work.

Evelyn visited Sir Samuel when the inventor was very old and blind, and was shown his "invention of writing, which was very ingenious; also his wooden Kalender, which instructed him all by feeling, and other pretty and useful inventions of mills, pumps, etc. He has newly buried £200 worth of music-books six feet under ground, being, as he said, love-songs, and vanity. He plays himself psalms and religious hymns on the theorbo." Sir Samuel believed in spells and witchcraft, and hesitated to prosecute a lawsuit because he was firmly convinced that the defendant had used, or was capable of using, charms to gain the victory over him. One of the fantastic wonders of the

age was the home of Winstanley, who built the first Eddystone lighthouse. If you kicked aside an old shoe, flung purposely in your way, "up started a ghost before you. If you sat down in a certain chair, a couple of gigantic arms would immediately clasp you in." The house was a perfect knickknackatory, as the people of that day would have said. The instant you seated yourself in an arbor built in the garden near a canal you "were sent out afloat into the middle of the canal, whence you could not escape till this man of art and science wound you up to the arbor." Evelyn gives an interesting account of the singular inventions of "that most obliging and universally curious" Bishop Wilkins, whose lodgings at Oxford he visited when the bishop was warden of Wadham College. Dr. Wilkins had contrived a talking statue, which was hollow, and connected with a tube through which a man a long distance off spoke the words which seemed to be uttered by the figure. With the assistance of that "prodigious young scholar, Mr. Christopher Wren," he had filled a gallery above his lodgings with a variety of shadows, dials, perspectives, and many other artificial, mathematical, and magical curiosities; a way-wiser, a thermometer, a monstrous magnet, conic and other sections, a balance on a demi-circle, marble curiously colored by Wren, and other scientific toys and instruments.

A favorite experiment in the seventeenth century was producing the apparition of a rose or other flower, and was called the process of the Palingenesis. "Having burnt a flower, by calcination, disengaged the salts from its ashes, deposited them in a glass vial, a chemical mixture acted on it, till, in the fermentation, they assumed a bluish and a spectral hue. The dust, thus excited by heat, shoots upwards into its primitive forms; by sympathy the parts unite, and while each is returning to its destined place, we see distinctly the stalks, the leaves, and the flower arise; it is the pale spectre of a flower coming slowly forth from its ashes. . . . This vegetable phœnix lies thus concealed in its cold ashes till the presence of heat produces this resurrection." When the ashes again cool it returns to death. "A corpse may give out its shadowy re-animation when not too deeply buried in the earth. Bodies corrupted in their graves have risen, particularly the murdered; for murderers are apt to bury their victims in a slight and hasty manner." Another scientific theory, as well as popular superstition, proved beyond peradventure by experiment!

Some members of the society were "impatient for romantic discoveries; miracles were required, some were hinted at, while others were promised." Of these wonders, Glanville, a man of acute and original intellect, who, though a firm believer in and defender of witchcraft, was yet somewhat skeptical in scientific

matters, wrote in his work on the progress of knowledge since the days of Aristotle: "Should these heroes [the F. R. S.] go on as they have happily begun," he said, "they will fill the world with wonders; and posterity will find many things that are now rumors verified into practical realities. It may be, some ages hence, a voyage to the southern unknown tracts, yea, possibly, the moon, will not be more strange than one to America. To them that come after us, it may be as ordinary to buy a pair of wings to fly into remotest regions, as now a pair of boots to ride a journey; and to confer at the distance of the Indies, by sympathetic conveyances, may be as usual to future times, as to us in a literary correspondence. The restoration of grey hairs to juvenilty, and renewing the exhausted marrow, may at length be effected without a miracle; and the turning the now comparative desert world into a paradise, may not improbably be expected from late agriculture. Those that judge from the narrowness of former principles and successes will smile at these paradoxical expectations. Antiquity could not have believed the almost incredible force of our cannons, and would have as coldly entertained the wonders of the telescope." Disraeli smiles at these dreams at the dawn of philosophy. What would he have thought had Glanville prophesied of steamships, railroads, telegraphs, sewing-machines, telephones, and other inventions of the nineteenth century, which were unknown in Disraeli's lifetime?

Gold-making was a favorite pursuit in the seventeenth century with our scientists. Sir Kenelm Digby's devotion to alchemy, which he regarded as science, led him to lavish money on impostors, and seek knowledge from very unlikely sources. He once went in disguise to consult the philosopher Descartes, and, hoping to obtain from him the secret of making *aurum potabile*, complained that life was too short for the accomplishment of the designs of a scientist. Descartes, though he did not give Digby the recipe for the golden elixir, replied that he had considered that matter; "to render a man immortal was what he could not promise, but that he was very sure it was possible to lengthen out his life to the period of the patriarchs." Sir Kenelm's well-known weapon, salve, or powder of sympathy, was recommended by him as a valuable remedy, though it was, of course, the most ridiculous quackery. "The wound was never to be brought into contact with the powder, which was merely powdered vitriol. A bandage was to be taken from the wound, immersed in the powder, and kept there till the wound healed." He was a firm believer in astrology, and attributed his happy marriage to the beautiful and talented Venetia Stanley, after a somewhat protracted courtship, to astrological influences. Digby gave Evelyn, at Paris, in 1651, some water which he "intended for a disolvent

of calx of gold," and which, though it smelled like aqua fortis, and tasted like vitriol, he insisted was "only raine water of the autumnal equinox exceedingly rectified, very volatile"; an assertion which led Evelyn to the conclusion that "Sir Kenelm was an arrant mountebank." Some time afterward, mentioning Digby's account of Lady Selenger's antipathy for roses, which he said she had to that degree that "laying but a rose upon her cheek when she was asleepe, it raised a blister," Evelyn remarks, "But Sir Kenelm was a teller of strange things."

Yet Digby had in Evelyn a not incredulous listener. In the winter of 1652 there lived in Paris, in extraordinary splendor and seeming wealth—the source of which was not apparent—an impostor, who nearly succeeded in selling Evelyn and his scientific friends a pretended secret for multiplying gold; but they discovered before the bargain was completed that the man was an egregious cheat. Not long afterward Evelyn visited Mark Antonio, a celebrated artist in enameling, from whom he heard strange tales concerning a Genoese jeweler, who, according to Antonio, "had the greate Arcanum, and had made projection before him severall times. He mett him at Cyprus travelling into Egypt, on return from whence he died at sea, and the secret with him, that else he had promised to leave it to him"—a legacy which the enameler believed would have enabled him to manufacture gold. Mark Antonio also told a marvelous story about a dwarfish person whom he saw come into a goldsmith's shop in Amsterdam, and ask the master to melt him a pound of lead, which, being done, the visitor threw into the crucible of molten metal a pinch of powder that he carried in the hollow pommel of his sword, and, after a few moments, pouring out a gold ingot from the crucible, he carried it off, saying, as he left the shop, "Sir, you will be paid for your lead in the crucible," where, sure enough, the goldsmith found four ounces of good gold; but he could never hear of the little transmuter of metals again, though he sought him throughout the city. "This," says Evelyn, who had seen so many wonderful new inventions during his travels in France and Italy, that he was in a continually expectant frame of mind, and almost ready to believe that projection powder was a scientific discovery—"this Antonio asserted with great obtestation, nor know I what to think of it, there are so many impostors and people who love to tell strange stories as this artist did, who had been a greate rover and spoke ten different languages." In May, 1653, Evelyn mentions in his diary the death from apoplexy of his "servant Hoare," meaning his private secretary, who "wrote those exquite severall hands," his illness being, it was supposed, caused by "tampering with mercury about an experiment in gold." The same year he records the receipt from Mon-

sieur Roupel of "a small phial of *Aurum potabile*, with a letter showing the way of administering it and the stupendous cures it had done at Paris." But the bottle was empty when Evelyn received it, the potable gold having by some accident all run out. A drop of liquid gold was regarded as a sovereign remedy for every disease in France in the seventeenth century, as we may learn from Molière's Physician in Spite of Himself, and was called the universal heal-all.

In June, 1705, Evelyn speaks of going to see Dr. Dickinson, the famous chemist, and having a conversation with him about the philosopher's elixir, which the doctor believed attainable, having seen projection himself by "one Mundanus, who sometimes came among the adepts, but was unknown as to his country and abode."

Ashmole, of museum fame, though rather a theoretical than practical alchemist, also had faith in potable gold as well as in other superstitions. He writes in his diary, April 11, 1668: "I took early in the morning a good dose of the elixir, and hung three spiders about my neck, and they drove my ague away." He says that the alchemist, if he would succeed, must carry on his labors in secret, and not let any one know of his undertakings but his good angel and himself. Sir W. Petty told Pepys that he had left in his will sums of money to be given as prizes to persons who should make certain inventions, among others "to him that could invent proper characters to express to another the mixture of relishes and tastes. And says that to him that invents gold he gives nothing for the philosopher's stone; for (says he) they that find out that will be able to pay themselves!"

The Fellows of the Royal Society were much interested in anatomy, and sometimes witnessed dissections of men or animals. Pepys writes, July 3, 1668: "To an alehouse; met Mr. Pierce, the surgeon, and Dr. Clerke, Waldron, Turberville, my physician for the eyes, and Lowre to dissect severall eyes of sheep and oxen, with greate pleasure and to my greate information. But strange that this Turberville should be so greate a man, and yet to this day had seen no eyes dissected, or but once, but desired Dr. Lowre to give him the opportunity to see him dissect some." Turberville was a celebrated oculist, and was recommended to Pepys by that illustrious philosopher, Mr. Boyle.

The Royal Society were in the habit of inviting distinguished foreigners who visited London to attend their meetings. Evelyn writes, August 30, 1680: "I went to visite a French gentleman, one Monsieur Chardine, who, having ben thrice in the East Indies, Persia, and other remote countries, came hither in our returne ships from those parts, and it being reported that he was a very curious and knowing man, I was desir'd by the R. Society

to salute him in their name, and to invite him to honour them with his company. Sir Jo. Hoskins and Sir Christopher Wren accompanied me. . . . He was sorry he could not gratify the curiosity of the Society at present, his things not being yet out of the ship, but would wait on them with them on his return from Paris, whither he was going next day, but with intention to return suddenly and stay longer here, the persecution in France not suffering Protestants—and he was one—to be quiet." Chardine went to the East in search of jewels and had become very rich. They "found him at his lodgings in his Eastern habit, a very handsome person, extremely affable, a modest, well-bred man, not inclin'd to talke wonders. He seem'd about 36 years old." Chardine was the author of the excellent and well-known volume of travels.

Frequently scientific parties visited the homes of English *virtuosi* who had cabinets of scientific or historical curiosities or inventions of their own to exhibit. Pepys mentions, May 1, 1665, meeting and joining Lord Brouncker, Sir Robert Murray, "the heart and soul of the Royal Society"; Dean Wilkins, and Mr. Hooke, curator of the society, who were going by boat and coach to dine with the inventor, Colonel Blount, and witness "the trial of some experiment about making coaches easy." After admiring their host's "long spring coach" and dining with him, the party went to Deptford, and "into Mr. Evelyn's (Sayes Court), which is a most beautiful place. . . . A lovely and noble ground he hath indeed. And among other varieties a hive of bees, so as being hived in glass, you may see the bees making their honey and combs mighty pleasantly. . . . It being dark and late I stayed not; but Dean Wilkins and Mr. Hooke and I walked to Redriffe; and noble discourse all day long did please me."

The transparent apiary to which Pepys alludes was a present from Dr. Wilkins, who invented it, to Evelyn. It was regarded as so great a curiosity that Charles II made an excursion to Sayes Court expressly to see it. Evelyn described the hive as built like a castle or palace, adorned with little statues, dials, and vanes, and so contrived that the honey could be removed without injuring the bees. Evelyn was a scientific horticulturist, and his gardens and orchards were the wonder and admiration of his contemporaries, one of whom described his grounds as a "garden exquisite and most boscaresque, and as it were an exempler of his book of forest trees"—the famous Sylva written for the Royal Society at the request of the Admiralty Board. August 4, 1665, Evelyn writes: "I call'd at Durdans, where I found Dr. Wilkins, Sir William Petty, and Mr. Hooke, contriving chariots, war rigging for ships, a wheele for one to run races in, and other

mechanical inventions; perhaps three such persons together were not to be found elsewhere in Europe for parts and ingenuity." Petty made fame and fortune by his inventions. Evelyn writes in 1655: "Came that renowned mathematician Mr. Oughtred to see me, I sending my coach to bring him to Wotton, being now very aged. Among other discourse he told me he thought water to be the philosopher's first matter, and that he was well perswaded of the possibility of their elixir; he believed the sun to be a material fire, the moone a continent, as appears by the late selenographers; he had strong apprehensions of some extraordinary event to happen in the following yeare, from the calculation of coincidence with the diluvian period; and added that it might possibly be to convert the Jewes by our Saviour's visible appearance or to judge the world." Such was the mixture of sense and nonsense which occupied the minds of superior men in the seventeenth century!

September 10, 1676, Evelyn mentions dining with the first astronomer royal, "Mr. Flamstead, the learned *astrologer* and mathematician, whom his Majesty had established in the New Observatorie in Greenwich Park furnished with the choicest instruments. An honest, sincere man."

Evelyn believed that diseased children had been healed by baptism, and that there were other well-attested modern miracles, and is careful to state that he planted the orchard at Sayes Court in the full of the moon; yet he was less credulous than many of his learned colleagues. In 1670 "a plaine, ordinary, silent working wench," whose arm three different times in July was powdered with red crosses arranged in a diamond-shaped figure, was brought to Sayes Court by friends who regarded this poor girl's malady as the result of a miracle, and wished the opinion on the case of an F. R. S. Evelyn was reminded of the "impostorious nunns" of Loudune, France, whom he had seen, and remembered that M. Monconys "was by no means satisfied with the stigmata of those nunns because they were so shy of letting him scrape the letters, which were Jesu, Maria, Joseph, as I thinke, observing they began to scale off with it, whereas this poor wench was willing to submit to any trial; so that I profess I know not what to think of it, *nor dare I pronounce it anything supernatural.*" "Curing by the touch," animal magnetism, or hypnotism, was not unknown in London in the seventeenth century, and "Gretrex and Stroaker" is mentioned in the Transactions of the Royal Society.

The members of the Royal Society considered themselves "intolerable losers" when prevented from attending the profitable and desirable meetings at Gresham College. "I now and then," one complains, "get a baite at Philosophy; but it is so little and jejune, as I despair of satisfaction 'till I am againe restor'd to the

society, where even your very fragments are enough to enrich any man that has the honour to approach you." He calls heaven the Royal Society above, "where those whose refined and excellent natures make them capable of the sublimest mysteries, and aspire after experimental knowledge, truly so called, shall be fill'd; and there without danger taste of the fruit of the tree which cost our unhappy parents so dear, shall meet with no prohibition of what is desirable, no serpent to deceive, none to be deceived."

Many of the members of the Royal Society, while distinguished for their patient industry, could not philosophize on the facts they had collected, and their grammar and literary style were open to criticism. Their published works were consequently ridiculed by their ever-watchful opponents. One chief victim of the wits was Sir Hans Sloane, noted, like Ashmole, for his museum. The brilliant Dr. King produced a parody or travesty on Sloane's valuable history of Jamaica (quoting verbatim his bulls and blunders), which is "one of the severest and merriest satires that was ever written in prose." Yet we find the society, as early as 1665, appointing a committee to consider the improvement of the English language. And in Evelyn's correspondence appears a long letter addressed to Sir Peter Wyche, Knt., chairman of the committee, in which he says that they ought to prepare manuals of grammar, orthography, and punctuation, and a lexicon of current, obsolete, and technical words. Out of this grew a project for the establishment of an institution similar to the French Academy. "And, indeed," writes Evelyn to Pepys, in 1689, "such was once designed since the Restauration of Charles II (1665), and in order to it three or four meetings were begun at Gray's Inn by Mr. Cowley, Dr. Spratt, Mr. Waller, the Duke of Buckingham, Matt Clifford, Mr. Dryden, and some other promoters of it. But by the death of the incomparable Mr. Cowley, distance and inconvenience of the place, the contagion and other circumstances intervening, it crumbled away and came to nothing; what straw I had gathered towards the bricks of that intended pyramid (having the honor to be admitted an inferior laborer) you may command and dispose of, if you can suffer my impertinences; and that which I have not shew'd you, the plan I drew and was laying before them for that designe, which was, I say'd, the polishing of the English tongue, and to be one of the first intentions and chiefest subjects of the Academists."

THE mental act of associating colors with words, etc., was observed in 1848 by Thorean, who wrote to Emerson that his Ellen said that she could tell the color of a great many words, and amused the children at school by so doing.

SKETCH OF JOHN COUCH ADAMS.

ONE of the most striking illustrations of the value and range of man's reasoning faculty is afforded by the substantially simultaneous calculation, on a purely mathematical basis, of the elements of the then unseen and unknown planet Neptune, and the prediction of the place in the sky where it would be found on a given day, by the Englishman Adams and the Frenchman Leverrier. While Leverrier succeeded in first attracting public attention to his work, Adams anticipated him in beginning the calculation and in bringing it to a satisfactory result.

Prof. J. W. S. Glaisher treats Adams's first paper, by means of which the new planet might have been discovered, as furnishing the final and inexorable proof of Newton's law of gravitation; and the day when it was taken to Greenwich—October 21, 1845—as therefore marking a distinct epoch in the history of gravitational astronomy.

JOHN COUCH ADAMS was born at Lancast, seven miles west of Launceston, Cornwall, England, June 5, 1819, and died at the observatory in Cambridge, January 21, 1892. His father was a tenant farmer; his mother had a small landed estate of her own, and had inherited her uncle's library, in which were a few books on astronomy. He was interested in these books, and made rapid progress at the village school, and was learning algebra before he was twelve years old, at which age he went to a private school at Devonport, where he had Mr. Grylls, a cousin of his mother's, as his teacher. While he studied, as usual, the classics and mathematics, astronomy was his favorite branch, and he was making notes and drawing maps of the constellations when fourteen years old; he read eagerly all the astronomical books he could find, and soon became interested, by the perusal of Vince's Fluxions, in the higher mathematics. In 1837 it was contemplated to send him to the University of Cambridge; in October, 1839, he entered St. John's College of that university. During his undergraduate career, according to Prof. J. W. L. Glaisher, he was invariably the first man of his year in the college examinations. In 1843 he was graduated as senior wrangler, being also first Smith's prize-man. The occurrence of a small constellation of mathematical senior wranglers at Cambridge about this time is noted in one of the biographies of Adams, viz.: Stokes in 1841, Cayley in 1842, and Adams in 1843,—all three of whom have since been professors, and famous. Adams was elected a Fellow of his college on the year of his graduation, and continued in that relation till 1852, when, he not having taken holy orders, his fellowship ex-

pired. In the next year he was elected to a fellowship in Pembroke College.

It was while still an undergraduate that Adams began the investigation of the irregularities of Uranus, that culminated in the discovery of the new, remote planet Neptune. The possibility of the existence of such a planet, acting upon the motions of Uranus, had been suggested by Bouvard in 1821. Mr. Adams's attention was drawn to the subject, according to Prof. Glaisher, by reading Airy's report upon recent progress in astronomy in the British Association volume for 1832–'33. On July 3, 1841, at the beginning of his second long vacation, when he was in his twenty-third year, he made the memorandum, "Formed a design at the beginning of this week of investigating, as soon as possible after taking my degree, the irregularities in the motion of Uranus which are yet unaccounted for; in order to find whether they may be attributed to the action of an undiscovered planet beyond it; and, if possible, thence to determine the elements of its orbit, etc., approximately, which would probably lead to its discovery."

Prof. Glaisher further relates the history of the calculations: "In 1843, the year in which he took his degree, he attempted a first rough solution of the problem, on the assumption that the orbit was a circle with a radius equal to twice the mean distance of Uranus from the sun. The result showed that a good general agreement between theory and observation might be obtained. In order to make the data employed more complete, application was made, through Prof. Challis, to the astronomer royal, for the results of the Greenwich observations of Uranus. When they were obtained, Adams undertook a new solution of the problem, taking into account the most important terms depending on the first power of the eccentricity of the orbit of the supposed disturbing planet, but retaining the same assumption as before with respect to the mean distance. In September, 1845, he communicated to Prof. Challis the values which he had obtained for the mass, heliocentric longitude, and elements of the orbit of the assumed planet. The same results, slightly corrected, he took with him to the Royal Observatory, Greenwich, on October 21, 1845. The paper which he left at the observatory on this occasion also contained a list of the residual errors of the mean longitude of Uranus, after taking account of the disturbing effect of the new planet, at dates extending from 1690 to 1840." Prof. Challis began the search for the planet on July 29, 1846, three weeks before it was in opposition, and continued the observations for two months. His plan was to sweep a zone covering the computed place of the body, and extending over 30° of longitude and 10° of latitude. "For the first few nights the telescope was directed to

that part of the zone in the immediate neighborhood of the place indicated by theory. Unfortunately, the observations were not immediately compared with each other, or Prof. Challis would have discovered, what he afterward found to be the case, that he had actually seen the planet on August 4th and August 12th, the third and fourth nights of observation. . . . On September 3, 1846, Adams communicated to the astronomer royal a new solution of the problem, supposing the mean distance of the planet as originally assumed, to be diminished by about the thirtieth part. The result of this change was to produce a better agreement between the theory and the later observations, and to give a smaller and therefore a more probable value of the eccentricity."

Leverrier's first paper relative to the subject was presented to the French Academy on November 10, 1845, and concerned the perturbations of Uranus produced by Jupiter and Saturn; but in it he also pointed to irregularities which could not be accounted for by the existing theory. In his second paper, June 1, 1846, he expressed the conclusion that the unexplained irregularities were due to an undiscovered planet exterior to Uranus. He calculated the longitude, but did not give the elements of the orbit of the disturbing planet. The place assigned by him to the supposed body differed by only one degree from that given by Adams in the paper which he had left at the Greenwich Observatory seven months earlier.

"Adams's researches," says Prof. Glaisher, "therefore preceded Leverrier's by a considerable interval; and in spite of the delay in carrying out the search, it had been carried on at Cambridge for nearly two months before the planet was found at Berlin. Adams's investigation may be regarded as having been completed on October 21, 1845, when he left his paper at the Royal Observatory. This was three weeks before Leverrier's memoir, showing that the irregularities could not be attributed to any of the known planets, was presented to the French Academy, and more than seven months before the presentation of Leverrier's second memoir. It is to be noticed that in this second memoir Leverrier did not give the elements of the orbit or the mass of the planet, which were contained in Adams's paper of October 21st."

A bitter controversy ensued over the question of priority in discovery, in which Mr. Adams took no part. He felt and expressed a warm appreciation for Leverrier; met him with great pleasure at Oxford in 1847; and was visited by him in the same year at Cambridge. A story was told of him for the first time by Dr. Donald MacAlister at the commemorative meeting at St. John's College, February 20, 1892, to the effect that several years ago, when a memorial volume was prepared to be presented to M. Pasteur as a testimonial of the appreciation of English men of

science for his labors, Prof. Adams subscribed his name, writing beneath it the motto, "*Hommage au compatriote de Leverrier.*"

The small number and volume of Prof. Adams's publications, after his calculations for the planet Neptune, have been remarked upon. He was, however, an industrious worker, calculating in every quarter of the mathematical field and in mathematical astronomy, and is said to have left a large mass of manuscript work, much of which is expected to prove valuable. The Adams prize, of about four hundred dollars a year, to be awarded every two years to the author of the best essay on some subject of pure mathematics, astronomy, or other branch of natural philosophy, was instituted by members of St. John's College soon after the discovery of Neptune, as a testimonial to the honor conferred on the college and the university by the investigation. In 1848 Mr. Adams began the determination of the constants in Gauss's theory of terrestrial magnetism. He resumed the work and was occupied with it in the later years of his life, but had not completed it at the time of his death. In 1852, having been elected in the previous year President of the Royal Astronomical Society for two years, he communicated to the society new tables of the moon's parallax, to be substituted for those of Burckhart. These tables were printed in the appendix to the Nautical Almanac for 1856.

His memoir explaining the secular variation of the moon's mean motion was communicated to the Royal Society in 1853. The problem baffled solution. The French Academy had at different times given prizes for explanations to Euler and Lagrange, but neither of these mathematicians had been able to discover any secular term; and Euler, considering it established that such a term could not be produced by the principles of gravitation, had recourse to the supposition of a resisting medium. Laplace announced in 1787, as the true cause of the phenomenon, the gradual diminution in the mean action of the sun produced by the secular variation of the eccentricity of the earth's orbit. Theories were also proposed by Damoiseau and Plana, agreeing in principle with Laplace's, but differing slightly in the numerical values assigned to the acceleration. Adams found that Laplace's explanation of the phenomena was essentially incomplete, and suggested corrections to all the theories. Some controversy ensued, at the end of which Prof. Adams was sustained. A calculation of the same problem, made by Prof. Airy in 1880, was also corrected by Prof. Adams.

Mr. Adams was appointed, in the fall of 1858, Professor of Mathematics in the University of St. Andrews, where he continued his lectures till the end of the session, in May, 1859; and late in 1858 he was made Lowndean Professor of Astronomy and Geometry at Cambridge. He held the last position till his death.

A part of his work in it was to lecture during one term in each year, generally on the lunar theory, but sometimes on the theory of Jupiter's satellites or the figure of the earth.

In 1867 he published an account of the results he had obtained with respect to the orbit of the November meteors, in the investigation of which he had co-operated with Prof. H. A. Newton, using the data and observations furnished by him. These calculations took notice of all the perceptible effects produced by the planets, and established the correctness of the period of thirty-three and a quarter years for the revolution of the meteoric body. In order to obtain a sufficient degree of approximation, it was necessary to break up the orbit of the meteors into several different parts, for each of which separate calculations had to be made. Prof. Adams afterward subdivided certain parts of the orbit of the meteors into still smaller portions, with a view of obtaining a closer approximation. The calculations on this subject have not been published, but they exist among his papers, and seem to be fairly complete.

A paper communicated to the Astronomical Society, in November, 1877, embodied a review of a memoir by Mr. G. W. Hill, of Washington, on the part of the motion of the moon's perigee, which is a function of the mean motions of the sun and moon. This paper is pronounced by Prof. Glaisher peculiarly interesting, because in it the author expresses his own views with respect to the mathematical treatment of the theory of the moon's motion. He seems to have preferred to treat the subject by its special problems; while he had great admiration for Delaunay's general theory.

Prof. Adams also paid much attention to pure mathematics, and treated many abstruse problems in a highly technical manner, in papers the very titles of which are an unknown language to all but accomplished mathematicians.

A large mass of papers which Sir Isaac Newton had left at his death, having been left to the University of Cambridge by Lord Portsmouth, it became Prof. Adams's task to arrange and catalogue the mathematical part of the collection. The work lasted many years, but proved very interesting to Prof. Adams, by casting light on the methods by which Newton had worked out his results.

On the resignation by Prof. Challis of the directorship of the observatory at Cambridge in 1861, Prof. Adams was appointed to succeed him, while he still continued in the Lowndean professorship. In 1870 the observatory began to co-operate in the scheme of the *Astronomische Gesellschaft* for the observation of all the fixed stars in the northern hemisphere down to the ninth magnitude, the observations being put under the charge of the first

assistant, Mr. Graham. The zone assigned to the observatory was that between 25° and 30° of north declination. As related to this work, Prof. Adams gave, in an appendix to one of the volumes of the Cambridge Observations, the formulæ and instructions which he had drawn up many years before for the formation of a proposed new fundamental catalogue, together with the mean places of the eighty-four fundamental stars from 1830 to 1870.

Prof. Adams was President of the Royal Astronomical Society in 1851–1853, and in 1874–1876, and had the honor of delivering the addresses in presenting the gold medal to Dr. Peters, Dr. Hind, D'Arrest, and Leverrier. In 1870, as vice-president, he delivered the address on the presentation of the medal to Delaunay. He himself received the medal in 1866 for his contributions to the development of the lunar theory. He received the Copley medal of the Royal Society in 1848. In 1881 he declined an offer of the position of astronomer royal. In 1884 he was one of the British delegates to the International Prime Meridian Conference, which met in Washington. He received honorary degrees from Oxford, Dublin, Edinburgh, the University of Bologna, and his own university; and he was a correspondent of numerous foreign learned societies.

Among his peculiar tastes in work Prof. Glaisher mentions the enjoyment he took in making calculations that called for long lines of figures, as illustrated in his calculation of Euler's constant to 263, and of some logarithms to 273, places of decimals. Few of his papers were produced spontaneously. In the majority of cases he was induced to give an account of some investigation of his own by the publication of a paper by some one else in which the same subject was treated. He was able to map out beforehand in his head the whole course of an investigation; and he rarely began to write till he had carefully thought out his subject, when he wrote straight on without interruption.

While astronomy and mathematics were his professed studies, he was interested in other branches of knowledge, was a man of most extensive general reading, was much attracted to special pursuits, and made a valuable collection of early printed books. His moral and intellectual qualities were well balanced.

Prof. Adams was attacked by a severe illness in October, 1889, but recovered and continued his mathematical work for several months. He was again attacked in June, 1890, by an illness from which he never fully recovered.

EDITOR'S TABLE.

PROGRESSIVE THEOLOGY.

WE note with great pleasure the issue by Messrs. Houghton, Mifflin & Co., of Boston, under the title of The New World, of a theological periodical which seems to us to be designed on truly progressive lines—to be, that is to say, rather an organ for the discovery of truth on all matters connected with theological belief than for the propagation or defense of the views of any particular theological school. The magazine is under the editorial management of Messrs. C. C. Everett, C. H. Toy, Orello Cone, and N. P. Gilman, names which of themselves vouch for the broad and liberal spirit in which the new enterprise is conceived, and for the scholarship which will be placed at its service. These gentlemen, in an editorial note, state that they "have no distrust of the scientific temper which, in many spheres of investigation, has accomplished such great results, or of the critical spirit which has led the way to a better understanding of every literature to which it has been applied." The number before us contains articles by Lyman Abbott, C. C. Everett, J. G. Schurman, W. R. Alger, C. H. Toy, J. Estlin Carpenter, Thomas R. Slicer, Edward H. Hall, and Charles B. Upton, as well as book-reviews by various hands. In all we note a liberal spirit worthy of this new departure in theological literature. Here and there, perhaps, there is a little lack of scientific exactness, as where Dr. Lyman Abbott professes to discover the "evolution of Christianity" in the fact that, while Jesus succeeded in feeding "five thousand men, besides women and children, seated in serried ranks on the ground," in our own day, "an organized benefaction, through the consecrated channels of commerce, so distributes to the needs of man that, in a truly Christian community, a famine is well-nigh impossible." Other articles, however, furnish a guarantee that, within the new review itself, such weak and, we must say, delusive analogies will not pass unchallenged. For example, in discussing The New Orthodoxy, Mr. Edward H. Hall deals in a very thorough-going manner with the evasions of what may be called the pseudo-liberal school—those who welcome criticism so long as it is not "destructive": as if the function of criticism were never to destroy—and who, in a general way, take back with one hand what they seem to give with the other. Mr. Hall might be fully trusted to point out to Dr. Abbott that, if the feeding of the multitude by Jesus was a mere matter of commissariat, the vaster distributions of to-day point to an evolution in social organization, not to an evolution of Christianity; while if the multitude were fed by a miracle, as the Christian world has hitherto believed, what we see to-day has no relation to it whatever. Mr. Hall contends, and rightly, that if the aid of criticism is to be invoked at all, it is vain to attempt to circumscribe its action. "Whoever," he says, "invokes the name of Science, invokes a great name. He calls to his aid a master, not a servant. Science has its own domain and, in that domain, its own laws and its own rights. It can not be dictated to; it dictates. It suffers no one to assign its limits, but goes wherever there is work for it to do. Wherever there is question of evidence, argument, testimony, or proof, there the scientific method belongs; and, once admitted, it must be given full play." These are brave words, and, if The New World shall present a selection of articles written in frank acceptance of these principles, it will deserve well of all lovers of the truth, even though some of

its writers may cling to less defensible positions. There is a great work for our new contemporary to do in freeing the religious sentiment from delusions which only serve to check its free expansion and development. Many now think that, in some mysterious manner, they ingratiate themselves with higher powers by disparaging and abusing their reasoning faculty; but The New World, if we do not mistake its mission, is prepared to teach a different lesson—namely, that the fullest development and greatest activity of the reasoning faculty are absolutely essential to the highest religious life. When man is a free being in the largest sense of the word, and has reconciled himself, once for all, to the conception of all-pervading law, his religious nature may then reach out for its own satisfactions, not only without dread of aught which it may be in the power of Science to reveal, but with a glad confidence that all further discoveries can only tend to a deepening of that spirit of reverence and self-reverence in which religion essentially consists. Science at last is coming into its own in this world in which its mission has so often been ignored or misunderstood, and in which the labors and sacrifices of its votaries have so often been repaid with persecution and reproach. The New World is a hopeful sign of the times, and we bespeak for it a liberal support from those who believe that, in religion as in science, there are better things in store for us than the world has yet seen.

COMMON SENSE WANTED.

Every day some new law is passed somewhere or other to protect people against the results of their own ignorance and folly; but it is comparatively seldom that we hear of any proposition of a serious or comprehensive kind to do away with the ignorance and folly which render, or seem to render, so many laws necessary. Popular education is believed by some to be doing this work about as fast as it can be done; but this we hold to be a serious error. There never was a time, we believe, when so many people were trading on the thoughtlessness and credulity of the masses as at present. The Post-Office Department spends a considerable percentage of the energy which it should devote to perfecting the mail service of the country in unsuccessful efforts to prevent the mails from being used to promote fraudulent schemes. The result, doubtless, is to more or less embarrass some swindling businesses; but as fast as one is suppressed another takes its place, and some that seem to have been suppressed have only changed their name and perhaps their base of operations. But, in addition to schemes that are unmistakably fraudulent, there are hundreds of at least dubious character that spread their nets in the advertising (sometimes even in the editorial) columns of the press. No offer is too grossly extravagant to captivate and delude some persons who might be supposed able to take care of themselves in an ordinary business transaction. We have known a man who could write a fair business letter send a dollar in response to an advertisement which stated that, for that sum, the advertiser would send a complete set of parlor furniture in black walnut and crimson plush to any address, carriage paid. This intelligent gentleman was very angry because, in return for his dollar, he got a few toy articles made of chips and rags and inclosed in a pasteboard box about six inches long by three broad, the whole thing weighing only a few ounces. The protests which he addressed, as we are informed, to the postal authorities were conceived in a fine tone of moral indignation, though the only part which the post-office had taken in the matter had been to convey to him a most harmless consignment of goods. So far as we could learn, it never occurred to him to pronounce himself an ass of high degree,

and not only an ass but an actual aider and abettor of fraud, seeing that it is just the silly persons who expect to get something for nothing who keep the army of cheats in provender.

This idea of getting something for nothing is indeed the main-stay and support of far the larger part of the fraud that exists in the world; and the first lesson in practical wisdom is to learn that the thing is impossible, and that nobody professes to give something for nothing, or large value in exchange for small value, except for some selfish and dishonest purpose. We have discussed the subject before in these columns, and again we ask, Why could not a special effort be made in our educational institutions, not merely to put the young on their guard against being deceived, but to call forth their contempt for all the dishonest and semi-dishonest devices which now exercise so great an attraction over the masses? Why should not the lesson be taught with iteration that the best way to get what we want is to give an honest equivalent for it, and that if this principle were more generally recognized everybody would get better value for his money or his labor than is now the case? The promoters of fraudulent enterprises are mere social parasites; they give no value, or at least no decent value, for the money they rake in, and the real workers of society have to tax themselves that these men may flourish. As to the word-making, text-finding, bean-guessing plans and devices which are so freely advertised, they ought to be beneath the contempt of all but the very weakest intellects in the community; yet how many people who can not be placed in that category take more or less interest in such things! "With all thy gettings," said one of old, "get understanding." Doubtless he meant common sense; and, if he spoke at all in the spirit of prophecy, he probably foresaw the time when, under a state-stimulated system of education, the intellectual gettings of people would be greatly increased in number, and yet common sense be very frequently left out.

LITERARY NOTICES.

SOCIAL STATICS, ABRIDGED AND REVISED; together with THE MAN *versus* THE STATE. By HERBERT SPENCER. New York: D. Appleton & Co. Pp. 420. Price, $2.

SOCIAL STATICS was Mr. Spencer's first book. As originally issued, in 1850, it bore the title Social Statics: or, the Conditions essential to Human Happiness specified, and the First of them developed. It was put forth as, in the words of the author, "a system of political ethics—absolute political ethics, or that which ought to be, as distinguished from relative political ethics, or that which is at present the nearest practicable approach to it." Mr. Spencer affirms at the outset that, living as they do in the social state, men can attain the greatest happiness only by seeking it indirectly. He then reasons out as a first principle controlling the pursuit of happiness that "every man has freedom to do all that he wills, provided he infringes not the equal freedom of any other man." Applications of this first principle constituted the rest of the original volume. Many of these applications, in a matured and completed form, have been comprised in the division of Mr. Spencer's Synthetic Philosophy dealing with Justice, hence they have been omitted from the new edition of the present work, or presented only briefly. The last eight chapters of the book, however, which treat of the regulation of commerce, education, currency, postal arrangements, and some similar functions commonly performed by governments, remain substantially as first published.

Besides the duplication of a large part of this work in Justice, another reason for revising Social Statics was that, in the years that have passed since it first appeared, Mr. Spencer had relinquished some of the conclusions drawn from its first principle, and had given up also one of the bases upon which he had formerly made that principle to rest. The omission of some parts was accordingly necessary in order to check misrepresentations of the views which he now holds.

Interesting indications of the direction in which Mr. Spencer's thought was tending forty years ago may be found scattered through this volume. Thus, on page 32 he declares that civilization is a part of Nature, hence its progress is all of a piece with the development of an embryo or the unfolding of a flower; and, provided that the constitution of things remains the same, this progress must result in the perfection of mankind. Again, on pages 121, 122 is a paragraph illustrating the specialization of functions and the adaptation of parts to their duties which goes on in the development of various kinds of organisms. This paragraph shows that in 1849, when it must have been written, Mr. Spencer had already entered upon the line of thought which led him up to the general law of evolution. Several passages give evidence that he had then discovered the operation in Nature of the process that has since become known under the name "natural selection." Thus on pages 203, 204 he says, "Partly by weeding out those of lowest development, and partly by subjecting those who remain to the never-ceasing discipline of experience, Nature secures the growth of a race who shall both understand the conditions of existence and be able to act up to them."

The Man *versus* The State consists of four essays combating paternalism, which were originally published as magazine articles, and are among the most able and vigorous of Mr. Spencer's miscellaneous writings. A postscript and a note have since been added.

OUTLINES OF LESSONS IN BOTANY. PART II. FLOWER AND FRUIT. By JANE H. NEWELL. Boston: Ginn & Co. Pp. 399. Price, 90 cents.

THE leading aim in this work is to direct pupils to the study of plants themselves. With the very practical purpose of securing sufficient material for study, the successive lessons deal with the flowers in season in New England and vicinity, to which region the book is specially adapted, from March to early summer. A few house-plants are introduced to help out the scanty blossoms of March. Later, wild flowers, the blossoms of forest trees and fruit trees, and the flowers of garden vegetables all receive attention. While the analysis of flowers occupies the greater part of this volume, attention is given also to the leaves, stem, and roots of the specimens studied. An appendix contains a schedule for plant description, with some fifty or sixty descriptions following this form. There are also a glossary, an index of plants, and a chart comprising sixty families designed to introduce pupils to the use of Gray's Manual. There are thirty-seven illustrations.

A HISTORY OF EPIDEMICS IN BRITAIN (664–1666). By CHARLES CREIGHTON, M. A., M. D. New York: Macmillan & Co. Pp. 706. Price, $4.50.

THE pestilence of 664 in England, known to tradition as the great plague "of Cadwallader's time," furnishes the starting-point for this history. But little can be told about this pestilence, for, besides an entry in the Irish annals, Beda's Ecclesiastical History is the only source of authentic information concerning it. Previous to the "black death" of 1348–'49, English epidemics were almost all famine-sicknesses. The author gives a chronological list of such pestilences, embracing more than forty, with full accounts of three of them, and notes concerning others. An early chapter is devoted to Leprosy in Mediæval Britain, from which it appears that much consideration was given to lepers in the middle ages, these unfortunates being deemed the special wards of Jesus Christ. The author believes, however, that the hundred or more hospitals mentioned under the name of lazar-houses in Dugdale's Monasticon were not exclusively for the care of lepers. Furthermore, contemporary descriptions of lepers indicate that several diseases were then known by the common name of leprosy.

The black death, or bubo-plague, of 1348–'49, produced a frightful mortality. Certain parish records show ten times the ordinary number of burials. During the fourteen months of its prevalence two thirds of the clergy of Britain were carried off, and one half of the whole population of London. Dr. Creighton's account of this pestilence includes an examination of the traditions which locate its origin in China and in Tartary, and a discussion of the theory of the bubo-plague. The social and economic consequences of the black death make up an interesting chapter,

and connect this history with the general history of the time. The next remarkable epidemic was the sweating-sickness, of which five outbreaks occurred between 1485 and 1551. The record of plague in the Tudor period is a story of frequent outbreaks, one of the most serious being the London plague of 1563. Jail-fevers, influenzas, etc., during the same period furnish material for another chapter. The "French pox" has a chapter by itself, another is devoted to small-pox and measles, and another to scurvy and other sicknesses attendant upon early voyages. The plagues of the seventeenth century down to 1665 are duly recorded, and then comes the "Great Plague," to which over twenty per cent of the population of London succumbed. The extinction of the plague in England, in 1666 or 1667, brings this history to a close. The work gives evidence of much thoroughness and great ability on the part of its author, and deserves to rank high in medical literature.

THE LAST WORDS OF THOMAS CARLYLE. New York: D. Appleton & Co. Pp. 383. Price, $1.75.

THIS volume contains Wotton Reinfred, a romance; and An Excursion (futile enough) to Paris, which were left among the author's papers at his death; and a number of letters written by Carlyle to Varnhagen von Ense in the years 1837 to 1857; together with two notes of Varnhagen about Carlyle's first visit to Berlin in 1852; and letters of Jane Welch Carlyle to Amily Bölte, 1843 to 1849. The romance, Wotton Reinfred, is Carlyle's only essay in fiction, and therefore possesses a distinctive interest. It was probably written soon after the author's marriage, and represents the earlier period of his literary development. In it the editor of the volume finds the first expression of ideas and doctrines afterward set forth with more formality in Sartor Resartus. Mr. Froude regards it as of considerable interest, from the sketches which it contains of particular men and women, who being now dead, and the incidents forgotten, any objection which may have existed to publication is now removed. Among these characters, according to Mr. Leslie Stephen, is "a curious portrait of Coleridge, thinly veiled." The Excursion to Paris is the unreserved daily record of a journey in company with the Brownings, when Carlyle paid a visit to Lord Ashburton. It presents a singularly vivid picture of the author's personality, and one which adds something to our knowledge of Carlyle the man.

ANNUAL REPORT OF THE BOARD OF REGENTS OF THE SMITHSONIAN INSTITUTION, TO JULY, 1890. Pp. 808. REPORT OF THE NATIONAL MUSEUM, FOR THE YEAR ENDING JUNE 30, 1889. Pp. 933. Washington: Government Printing-Office.

THE permanent funds of the Smithsonian Institution, bearing interest at six per cent, amount to $703,000. The inadequacy and insecurity of the buildings continue to be subjects of complaint. The Institution was able during the year covered by the report to do rather more for the encouragement of original research than it had done for several years past. The project for securing an astro-physical observatory and general laboratory had assumed definite shape. Solid foundation piers had been built under the temporary shed, and a number of instruments had been procured, of which the siderostat is probably the largest and most powerful instrument of its class ever constructed. The work of exploration was carried on through the Bureau of Ethnology and the National Museum; and some rare and valuable collections were obtained. A few small grants from the Smithsonian fund, "commensurate rather with the abilities of the Institution than with its wishes," were made to aid in physical science—in addition to the aid largely given to biological and ethnological science through the Museum, Bureau of Ethnology, and Zoölogical Park. One of the important features of the year's history of the Institution was the passing of the National Zoölogical Park under its control. A complete description of the park is given. The general appendix, which constitutes the larger part of the volume, contains a miscellaneous selection of papers, some of them original, embracing a considerable range of scientific investigation and discussion. The National Museum now contains not far from three million specimens. The increase during the year covered by the report is much smaller than in any previous year since the completion of the Museum building. The difference is accounted for to

a large degree by the fact that the exhibition rooms and storage halls being filled to their utmost capacity, it has become necessary to cease to a large degree the customary efforts to add to the collections. Besides other features, accounts are given of work in the scientific departments, the library and publications, the work of the Museum preparators, accessions, co-operation of bureaus and officers of the Government, and explorations; considerable space is given to describing the participation of the Smithsonian Institution and the Museum in Centennial Exhibitions at Cincinnati and Marietta, Ohio; and eight papers are published describing and illustrating collections.

GAMES, ANCIENT AND ORIENTAL, AND HOW TO PLAY THEM. By EDWARD FALKENER. London and New York: Longmans, Green & Co. Pp. 366. Price, $6.

THE author believes in the usefulness of games because they afford needful relaxation to the mind, pleasant diversions to the invalid and the afflicted, and means of bringing friends together and promoting acquaintance and fellowship. He directed his attention many years ago to the games of chess, draughts, and backgammon, and to the formation of magic squares. Elaborate works have been written on the history of these games, and instead of exploiting this branch of the subject over again, he has preferred to discuss the practical rules and principles of each game. He expresses the opinion that students may find that the games which were established in years gone by contain merits that are not always found in the new and fanciful conceits of the day. The first place is given to the games of the ancient Egyptians, with the results of Dr. Birch's researches on the subject. The games are Tau, or Robbers, which was afterward played and called by the same name, *Ludus Latrunculorum*, by the Romans; *Senat*, which is still played by the modern Egyptians as *Seega;* Han, or the game of the Bowl; the Sacred Way, the *Hiero Gramme* of the Greeks; and *Atep*, which is played by Italians as Mora. Under the head of chess are given Indian, Chinese, Burmese, Siamese, Turkish, Tamerlane's, and double chess, and the game of the Maharajah and Sepoy; of draughts, Polish and Turkish draughts, *Wei-K'i* and *Go*, or the Chinese and Japanese game of inclosing; German, Turkish, and Indian backgammons. A considerable variety of magic squares are described, and all the games are illustrated with photographic reproductions and with diagrams.

THE OAK: A POPULAR INTRODUCTION TO FOREST BOTANY. By H. MARSHALL WARD, F. R. S., F. L. S. Modern Science Series, No. III. New York: D. Appleton & Co. Pp. 175. Price, $1.

FOR many persons trees have an interest which is not possessed by the lowlier members of the vegetable kingdom. Trees also are what the modern art of forestry is concerned with, and those who become interested in this subject on account of its economic or sanitary bearings are very apt to want to know something about the way in which trees grow. To all such persons Prof. Ward's book will be very welcome. In a brief introduction the author describes the general habit of the oak, and then, starting with the acorn, he describes the unfolding of the embryo, the development of the young plant, and the form and functions of the mature tree. There is a chapter on the structure and technological peculiarities of oak timber, followed by another dealing with the cultivation of the oak, and the parasites and fungi which infest it. A number of illustrations are given, showing the appearance of oak wood injured by various fungi. Lastly, the relationships of the oaks receive brief consideration.

THE WORLD-ENERGY AND ITS SELF-CONSERVATION. By WILLIAM M. BRYANT. Chicago: S. C. Griggs & Co. 1890. Pp. 304.

THIS is a metaphysical inquiry into the fundamental conceptions of the universe. The author holds that the laws of thought are necessarily the laws of things, and takes perfect consistency in consciousness to be the ultimate and absolute ground of all certitude. From this basis he attempts to formulate the universe, and reaches the conclusion that the one permanent reality of which the world we know is a manifestation is spirit. Stated in his own words, the conclusion to which his argument leads is:

"The world-energy is God. Its self-conservation is the eternal process of creation. 'Evolution' is the temporal aspect of

this process. The self-unfolding of God culminates in man. For man is the son of God."

Though the author's argument shows wide reading and much acute thinking, he can not be said to have a happy mode of expression, or the power of putting clearly the thought in mind. The reader soon finds himself lost in a maze of contradictions and wandering in a wilderness of words which convey few or no definite ideas. Very little intellectual good would seem to come from discussions of this nature. You begin and end nowhere, with nothing proved or provable. This is not to say that it is not desirable and important to have clearness and definiteness in our fundamental notions of things, but this is hardly to be attained by spinning a logical web out of our inner consciousness, and trying to find its justification in an assumed harmony between the laws of thought and things.

MONEY, SILVER, AND FINANCE. By J. HOWARD COWPERTHWAIT. New York: G. P. Putnam's Sons. Pp. 242.

THE author claims to have tried to answer the silver question by arguments based both upon the truths of financial science and upon the principles which underlie the operation of business. He hopes that in this volume the busy man of affairs may find some scientific points which may hitherto have escaped his attention; the student in finance a portrayal of business ways; and other readers may find their chain of evidence against silver fallacies more firmly made up. He thinks that besides "treating free coinage," sound finance demands a repeal of the present silver law, and nothing less. "Whether it be possible or not to frame a banking and currency act which shall be acceptable where money is scarce and not too objectionable elsewhere, the war against silver theories must be continued until there shall be effectively presented to the strong common sense of the American people the ludicrous spectacle of thousands of men devoting their time and labor to taking silver out of the mines, where it could do no harm, for the purpose of placing it in the Treasury's vaults, whence its monstrous bulk menaces the industries and the general prosperity of the country." In his succeeding chapters the author discusses the evolution of money, trades, and finance; the movements of prices; India and her silver rupee; prices, wages, and labor-saving machinery; the debtor class and foreign exchange; foreign exchange under normal and under abnormal conditions; the views of representative advocates of silver; ultimate redemption; the old volume-of-money theory; the present silver and currency law; international conferences, and bimetallism.

AN INTRODUCTION TO CHEMICAL THEORY. By ALEXANDER SCOTT. New York: Macmillan & Co. Pp. 274. Price, $1.25.

THIS is a text-book designed to supplement laboratory work, and such books as are mainly confined to the enumeration of facts, by supplying that knowledge of principles and laws which is needed to bind chemical facts together in the mind of the student. The author assumes that users of this book will have a fair knowledge of the chemical properties of substances, and have access to a teacher. "For this reason," it is stated in the preface, "references have frequently been made to matters somewhat outside the subject under discussion, for the purpose of stimulating the more inquiring student, without, at the same time, perplexing those less so. . . . As far as possible, all very debatable matter has been omitted, and it is for this reason, for example, that the account of the theories of solution has been made very short."

THE MICROSCOPE IN THEORY AND PRACTICE. By CARL NAEGELI and S. SCHWENDENER. New York: Macmillan & Co. Pp. 394. Price, $2.60.

ONE of the most thorough and scientific of treatises on microscopy is here presented in an English dress. The translation comprises the authors' work, Das Mikroskop, except Parts VIII, IX, and X, all copies of which, together with the woodcuts illustrating them, were lost by a fire soon after the sheets were printed. The volume opens with an explanation of the theory of the construction of the several parts of the microscope, embracing calculations of the paths of rays passing through the lenses, determinations of the positions of images, of the optical power of instruments, and various other problems. The division of the work on testing

embraces testing the optical power, the spherical and the chromatic aberration, the flatness of the field of view, and the centering. The theory of microscopic observation, or the interpreting of microscopical images, is treated with much thoroughness. Technical microscopy receives due attention, and there are chapters on the simple microscope and the lantern microscope. The volume closes with an account of the phenomena of polarization. Over two hundred figures and diagrams illustrate the text.

LABORATORY MANUAL OF CHEMISTRY. By JAMES E. ARMSTRONG and JAMES H. NORTON. American Book Company. Pp. 75. Price, 50 cents.

THIS manual consists of directions for one hundred and sixty-four experiments, accompanied by questions designed to call the attention of pupils to the principles which the experiments reveal. It is designed to be used with Eliot and Storer's Manual of Chemistry, or any other good text-book of elementary chemistry. The course here laid out is designed to occupy a class three hours a week for forty weeks. There are as many blank pages for notes as printed pages in the volume, and thirty cuts showing the forms and use of apparatus are given. The experiments include the tests commonly used in qualitative analysis.

THE PLANT WORLD. By GEORGE MASSEE. New York: Macmillan & Co. Pp. 222. Price, $1.

THE adult who wishes to obtain a general view of the vegetable kingdom will find this book a very competent guide. Its seven chapters deal respectively with plant architecture, chemistry and physics of plant life, protective arrangements, reproduction, relationship, geographical distribution, and fossil plants. The workings of evolution in the vegetable world are made especially prominent in this volume, and the conception of a plant as a living organism is strongly insisted upon. The text is illustrated with fifty-six cuts.

FOSSIL BOTANY. By H. GRAF ZU SOLMS-LAUBACH. New York: Macmillan & Co. Pp. 413. Price, $4.50.

IN the translator's preface this treatise is described as "the only critical digest as yet published of our present knowledge of fossil plants from the point of view of botanical morphology." It is based upon university lectures delivered by Count Solms-Laubach in Göttingen. The ground covered by this work comprises the thallophytes, archegoniatæ, and gymnosperms, but excluding the angiosperms. There are forty-nine illustrations, and the volume has a bibliography of seventeen pages and an index.

THE JEW AT HOME. IMPRESSIONS OF A SUMMER AND AUTUMN SPENT WITH HIM. New York: D. Appleton & Co. Pp. 105.

THE author, who professes to have gone to southeastern Europe in the summer of 1891 with no thought of the Jew or his affairs in his head, by some fortune saw him almost daily for five months under all conditions of life, at Brody and Lemburg, in Austrian Poland; at Marámaros Sziget, in Hungary; at Berdicheff and Kiev, in Russia; and at other places, and formed a very poor opinion of him and his manner of living. He describes what he saw, or rather, perhaps, his impressions of what he saw, in very strong language, and illustrates his descriptions with pictures which are, at least, strongly characteristic. The result of the whole is the representation of "The Jew at Home" as an odious and repulsive object, whose habits make him deserving of the scorn that he receives. Grant that this is so—and we have enough representatives among us of that class of Hebrews who are not pleasant associates—the race has in other regions furnished enough high-minded and enterprising citizens, and has distinguished itself sufficiently by liberal and benevolent enterprises, to enable us to know that it is still capable of better things. The author acknowledges this in substance, and in view of the fact and of his acknowledgment, we regret that he could not, while truthfully, as he claims to have done, describing the degradation to which centuries of contumely and maltreatment have reduced certain classes of Jews, have spoken of them in less harsh terms and with more hopefulness of their ultimate redemption under more favoring circumstances. One view he suggests, however, is worth considering, and is of weight proportioned to the degree of truthfulness contained in it: that is, that these Jews are not real, pure Jews, but a mixed

race who have preserved of the Jews chiefly their language and the form of their religion. We agree with him in his "last word," which is simply this: "Treat the Jew, if he is brought to you, as an ordinary man; grant him no advantages you would not give his Austrian, Polish, or German fellow-countrymen, no matter what his religion is. Make him an Englishman or an American, break up his old customs, his clannishness, his dirt, and his filth, or he will break you."

OUTLINES OF THEORETICAL CHEMISTRY. By LOTHAR MEYER. Translated by P. P. BEDSON and W. C. WILLIAMS. London and New York: Longmans, Green & Co. Pp. 232. Price, $2.50.

THE present volume differs from the author's Modern Theories of Chemistry in being a smaller and less technical treatise. Being addressed not only to the student but also to the friend of science who wishes to keep informed as to the progress of chemical investigation, the book does not contain any great number of the numerical results of observations and measurements, nor any detailed descriptions of experimental methods. It is, therefore, a general review of the subject of chemical philosophy in which details have not been allowed to rise into prominence. The author, of course, needs no introduction or commendation to any one who is acquainted with modern chemistry.

In the *Report of the Commissioner of Education for 1888–'89*, the commissioner, Dr. *William T. Harris*, presents first a general statistical exhibit of education in the United States. From these statistics it appears that the enrollment is about ninety per cent of the number of children between six and sixteen years of age in the whole country, which is as large as could be expected. The South is manifesting a great and increasing interest in public schools, and in the past nineteen years has more than doubled its expenditure *per capita* for education. A prominent feature of this report are the accounts of education in various foreign countries, prepared by specialists of the bureau, and the comparisons with education in the United States for which these accounts furnish material. Dr. Harris calls attention to the fact that the French and German children devote much less time than the American to memorizing the spelling of words. "Mechanical memorizing," he continues, "is the much-lamented characteristic of our common schools. It is evident that such must remain their characteristic so long as English-speaking children memorize, like the Chinese, the arbitrary spelling of more than ten thousand words before they can write the language with readiness." The training of teachers is another subject to which much attention is given, the report embracing papers on The Inception and Progress of the Normal-school Curriculum, The Teaching Force of New England from 1866 to 1888, and Professional Work in the Normal Schools of the United States. Chapters on courses of study in city schools, manual and industrial training, compulsory attendance laws, State text-book laws, and miscellaneous educational questions are included in the first volume of the report. The second volume contains the usual statistics of schools and colleges, and of the education of special classes, and an alphabetical list of the publications of the Bureau of Education from 1867 to 1890.

The *Report of the Smithsonian Institution* for 1889–'90 contains an account of the progress that has been made in establishing the National Zoölogical Park at Washington, together with the usual information about the work of the Institution for the year. Appended to the report are some thirty papers on a wide variety of scientific subjects, a number of them being illustrated.

The Journal of Proceedings and Addresses of the National Educational Association, for 1891, makes a handsome octavo volume of about nine hundred pages. Besides an account of the proceedings of the Association and reports of committees at the Toronto session, the Journal contains the papers read, together with abstracts of the discussions which they called forth. A wide variety of topics in all departments of educational work is treated in these papers.

A booklet which has attracted much attention and been read with interest in religious circles is entitled *Not on Calvary: A Layman's Plea for Mediation in the Temptation in the Wilderness*, and is published by Charles T. Dillingham, New York. It presents a new view of the life and office of Christ while on the earth, which the author

hopes may be more acceptable and easier of credit to those who doubt concerning the present accepted view. Not "Calvary"—the crucifixion—according to this view, was the culmination of Christ's life work, and marked the accomplishment of his mission, but the temptation in the wilderness, in which "our Lord literally bought back the spiritual freedom of mankind through the spiritual danger that he, guarded with the weakness of the flesh, was presumed to encounter when he was led by the Spirit into the wilderness."

The *Elements of Economics of Industry*, by *Alfred Marshall*, is an abridgment of the first volume of the author's Principles of Economics, noticed in our June number. The reduction of the larger work has been effected by the omission of many discussions on points of minor importance and of some difficult theoretical investigations, thus allowing arguments that are retained to be given in full. A chapter on trade-unions is included in the present volume, although in the larger work this subject is postponed to a later stage. (Macmillan, $1.)

The results of extended study are embodied in *The English Language and English Grammar*, by *Samuel Ramsey*. The former part of the book is a general account of the origin and present condition of our mother-tongue, considerable attention being devoted to pronunciation and spelling. The latter part is a treatise on the nature and uses of the parts of speech, closing with some suggestions to young writers. Throughout the volume the author gives his personal impressions freely on controverted matters, though acknowledging, as for example in his analysis of the sounds in English speech, that others see these things differently. (Putnam, $3.)

PUBLICATIONS RECEIVED.

Abbe, Cleveland. Memoirs of Jonathan Homer Lane and William Ferrell. Washington. Pp. 48.

Abbott, W. L. Catalogue of Collection of Ethnological Objects from Kilimanjaro, East Africa. United States National Museum. Pp. 50.

Agius, J. Jimeno. La Reforma de la Ortografía Castellana. Imprenta de La Patria, Balparaiso. 32 p. Prezio, zinqo zentabos.

Ashley, Hon. J. M. The Impending Political Epoch. New York: Evening Post Printing House. Pp. 88. 20 cents.

Bailey, L. H. Cross-breeding and Hybridizing. New York: Rural Publishing Company. 40 cents.

Barnes, Almont. Agriculture of South America. Washington: Department of Agriculture.

Barter, S. Wood-work: the English Sloyd. New York: Macmillan & Co. Pp. 341. $2.

Beddard, Frank E. Animal Coloration. New York: Macmillan & Co. Pp. 288, with Plates. $3.50.

Campbell, John P. Biological Teaching in the Colleges of the United States. Washington: Bureau of Education. Pp. 188.

Churchill, Lord Randolph S. Men, Mines, and Animals in South Africa. New York: D. Appleton & Co. Pp. 337, with Map and Plates. $5.

Ciaffi, Francesco. Il Baratto dei Biglietti di Bianca (Exchange of Bank Notes among Banks of Circulation and Forced Currency in Italy). Subiaco.

Dawson, George M., and Sutherland, Alexander. Geography of the British Colonies. New York: Macmillan & Co. Pp. 330. 80 cents.

Dolbear, A. E. Matter, Ether, and Motion. Boston: Lee & Shepard. Pp. 334.

Fernow, B. E. Timber Physics. Preliminary Report. Washington: Department of Agriculture. Pp. 68, with 6 Plates.

Fessenden, C. Elements of Physics. New York: Macmillan & Co. Pp. 229. 80 cents.

Foster, Michael, and others, Editors. The Journal of Physiology, Vol. XIII, Nos. 3 and 4. Cambridge, England. Pp. 344, with Plates. Nine shillings.

Gomme, George Lawrence. Ethnology in Folk Lore. New York: D. Appleton & Co. Pp. 203. $1.

Gould, George M., M. D., Philadelphia. The Etiology, Diagnosis, and Treatment of the Prevalent Epidemic of Quackery. Pp. 24.

Griffith, William. Anthracite Coal Production of Pennsylvania. Chart. P. 1.

Hale, George E. Solar Photography at the Kenwood Astro-physical Observatory. Pp. 11, with 2 Plates.

Hale, Horatio. Language as a Test of Mental Capacity. Pp. 46.

Hatch, F. H. Mineralogy. New York: Macmillan & Co.

Homan, George. The Relation of Land Monopoly to Population Health. Pp. 9.—Land Liberation as a Public Health Measure. Pp. 7. Concord, N. H.

James, George Francis. Proceedings of the First National Conference on University Extension. Philadelphia: J. B. Lippincott Co. Pp. 292. $1.50.

Japan. Journal of the College of Sciences of the Imperial University, Tokyo. Vol. V. Part I. Pp. 147, with 14 Plates.

Knight, George W. The History of Higher Education in Ohio. Washington: Bureau of Education. Pp. 258.

List, N. A. The American Charts. Investigations in Literary Archæology. Omaha, Neb.

Lydekker, R. Phases of Animal Life, Past and Present. New York: Longmans, Green & Co. Pp. 248. $1.50.

McDonald, Marshall, Commissioner. Bulletin of the United States Fish Commission. Washington: Government Printing-Office. Pp. 497.

Maginnis, Arthur. The Atlantic Ferry; its Ships, Men, and Working. New York: Macmillan & Co. Pp. 304. $2.

Maxwell, James Clerk. A Treatise on Electricity and Magnetism. New York: Macmillan & Co. 2 vols. Pp. 506 and 500, with Plates. $8.

Missouri Botanical Garden. Third Annual Report. St. Louis. Pp. 170, with Plates.

New York Academy of Sciences. Annals. Vol. VI, Nos. 5 and 6. Pp. 116.—Transactions, December, 1891, January and February, 1892. Pp. 64, with Plates.

Not on Calvary. New York: Charles T. Dillingham & Co. Pp. 46.

Parsons, Eugene. Tennyson's Life and Poetry, and Mistakes concerning Tennyson. Chicago. Pp. 32. 15 cents.

Pickering, Edward C. Investigations of the New England Meteorological Society for 1890. Cambridge, Mass. Pp. 156, with 5 Plates.

Quatrefages, A. de. Darwin et ses Précurseurs Français (Darwin and his French Precursors). Paris, France: Félix Alcan. Pp. 273.

The Republican Magazine, Vol. I, No. 1. Monthly. New York: Republican Magazine Co. Pp. 82. 25 cents. $3 a year.

Romanes, George John. Darwin, and after Darwin. I. The Darwinian Theory. Chicago: Open Court Publishing Company. Pp. 460. $2.

Ruschenberger, W. S. W. A Sketch of the Life of Joseph Leidy. Philadelphia: MacCalla & Co. Pp. 64.

Salisbury, Rollin D., Madison, Wis. The Drift of the North German Lowland. Pp. 28.

School of Applied Ethics, Plymouth, Mass. Programme of the Session of 1892. Pp. 20.

Sedgwick, William T., and Hazen, Allen. Typhoid Fever in Chicago. New York: Engineering News Publishing Company. Pp. 21. 10 cents.

Semple, C. E. Armand. Elements of Materia Medica and Therapeutics. New York: Longmans, Green & Co. Pp. 480. $3.

Smock, John C., State Geologist. Annual Report of Geological Survey of New Jersey for 1891. Pp. 270, with Maps and Plates.

Société des Arts. Bulletin de la Classe d'Industrie et du Commerce. Geneva, Switzerland. Pp. 20.

Superior and the Sault Canal, Commerce of. W. E. Street, Statistician. Pp. 80.

Tammany Hall, The Political Mission of. New York: A. B. King. Pp. 30. 10 cents.

Thomson, William H., M. D. Materialism and Modern Physiology of the Nervous System. New York: G. P. Putnam's Sons. Pp. 112.

Tremain, Mary. Slavery in the District of Columbia. New York: G. P. Putnam's Sons.

Walker, Sydney F. How to light a Colliery by Electricity. New York: Macmillan & Co. Pp. 36. 75 cents.

Woodhull, Victoria Claflin, and Zula Mano. The Garden of Eden and the Proposal. London. Pp. 98.

World's Columbian Exhibition, Chicago. Plan and Classification of Department M (Ethnology, Archæology, History, etc.). Pp. 27.

Yatabi, Rijo Kichi. Iconographia Floræ Japonicæ. Descriptions, with Figures, of Plants Indigenous to Japan. Tokyo. Pp. 170, with Plates.

Zoölogical Society of Philadelphia. Twentieth Annual Report. Pp. 21.

POPULAR MISCELLANY.

Anthropology at the World's Fair.—Prof. F. W. Putnam, the distinguished anthropologist of Cambridge, Mass., has outlined a most attractive and important exhibit of anthropology at the World's Fair. The department will occupy the northern half of the gallery of the Main Building and also a strip of land along the lagoon; on this land groups of native American peoples will be living in their natural habitations and surroundings. There will be a representative exhibit of the remains of prehistoric man in America, and large models of the most noteworthy of their works, such as the Serpent Mound and Fort Ancient. Central America will be well represented. Along with this there will be an exhibition of primitive industries, customs, and the like. The section of physical anthropology will illustrate modern methods of recording bodily characteristics, and will show charts recording the results of many thousand measurements. A large body of workers are now engaged in measuring native Americans in all parts of the land. Measurements of children are also being gathered for the study of the development of physical characteristics. This is a large and important undertaking, from which results of great scientific value are sure to come. With this department there is also connected the department of history, so that the exhibit of primitive man and his works is followed by that of the men whom Columbus met, and thus prepares the way for the exhibit of the historical changes in America during the last four centuries. The comprehensive scope of the exhibit is noteworthy, and under the leadership of Prof. Putnam an exhibit creditable to American science is assured.

Experimental Psychology at the World's Fair.—Those who have been interested in the growth of the new psychology will be glad to learn that there will be made at the World's Fair an exhibit of the methods and results of this young science. There will be in operation throughout the six months of the exposition a psychological laboratory in which simple tests will be made of the senses, sense-judgments, rapidity of movements, and simple mental processes, memory, and so on; the data thus accumulated will be statistically utilized to obtain normal standards. There will also be exhibited apparatus employed in psychological research, results obtained, as illustrated by charts, diagrams, photographs, etc.; and as complete a representation of recent psychological activity as the facilities will admit. The department is in charge of Prof. Joseph Jastrow, of the University of Wisconsin, and is a part of the general department of which Prof. F. W. Putnam is chief.

A Portrait of William Bartram.—When the sketch of the Bartrams was published in

the April number of the Monthly, we were not able to find any authentic portrait of either of them, or to learn that any existed. The publication of the sketch called out from Dr. W. H. Mills, of Syracuse, N. Y., the information that an engraved portrait of William Bartram was in existence, and formed the frontispiece to the second volume of the Cabinet of Natural History and American Rural Sports, published in Philadelphia in 1832 by J. & T. Dougherty. Through the kindness of Dr. Mills we have been able to procure this volume, and to have a copy made of this picture. Concerning the authenticity of the portrait, the statement is made in the Biographical Sketch of William Bartram, which is the first article in the volume, that "the accompanying portrait is a correct likeness of Mr. Bartram, and the only engraved one ever given to the American public." It will be observed that the date of the publication of this portrait was only nine years after Mr. Bartram's death.

The Schools of New York State.—According to the Report of State Superintendent Draper, while the number of children of school age in the State of New York appeared to be 22,823 less than in 1890, the number of children in attendance on the public schools (1,054,044) was greater by 11,884. Besides these, the private schools reported an attendance of 157,603, and the normal schools, academies, colleges, etc., 69,392 pupils of school age in 1891. Comparative tables of attendance show a steady increase in cities (270,926 to 513,066) since 1861, while the attendance in towns has fallen from 601,928 to 540,978. The superintendent calls attention to the insufficiency of the laws for compulsory attendance, and in view of crude features in the laws of some other States, he recommends the formation of a State Educational Commission, with sufficient powers to consider the whole subject of the school laws of the State. In view of the weakness of some of the school districts, the superintendent favors the consolidation of small and weak districts when it can be brought about without serious inconvenience to the children of school age. It is not to be overlooked, however, that the school must be at a convenient distance. In Massachusetts provision is made for the transportation of children to distant schools, and profitless schools have been abolished, while the children are now instructed for a longer term under teachers of more experience and skill. The superintendent recommends the township system of school organization for consideration. An increasing interest in Arbor Day is noticed. The celebrations are usually marked by appropriate literary exercises, with many ingenious and elaborate programmes. Interest in this work has been stimulated by the offer, by Mr. William A. Wadsworth, of prizes for the best-kept school-grounds. The vote upon the question of a State flower has resulted in a majority for the rose over the golden-rod. The attempt to provide text-books to be published by the State has resulted disastrously wherever it has been made. The superintendent thinks that the result of such a policy would be bad, even if it were seemingly successful. It would discourage authorship, discontinue competition among makers, and stop the constant improvement in the matter, style, and character of the books which has been marked in the past.

Barrel-making.—Few people, says Chambers's Journal, though all are familiar with the barrel, have probably been at pains to consider the skill and ingenuity which have succeeded in bringing to perfection an invention as scientific as beneficial all the world over; and probably fewer still are conversant with the brain-power and time which have been expended in attempts to produce machinery for manufacturing them. Barrels were in use as far back as the time of Pliny, who says they were invented in the Alpine valleys. A cask is a double conoid—that is, it has its greatest diameter or its bulge or belly in the center. The stave is curved lengthwise to form the bulge and crosswise to form part of the circumference of the cask; while the edges must receive the exact bevel to fit those on either side along their entire length. Then the staves have to be "chimed" or beveled at the ends, and furnished with a "croze" or groove, into which to fit the heads; and hooping completes the manufacture of the cask. A new invention, by a Mr. Oncken, is in full operation at Merxem, in Germany, for turning out casks from one piece of wood. In the process the stem of a tree is cut into lengths corresponding to

the size of the cask. These lengths are then boiled for two or three hours in a closed vessel, while a current of electricity is passed through the water. The wood is thereby softened so that it can be cut, in a machine rotating the log in the same manner as the ordinary lathe, into a sheet of any desired thickness. The sheets are then passed through a grooving machine and grooved. Another machine seizes the sheet between two arms, and by means of knives cuts a series of mortices or slots around the sides, so as to give them, when made up, the desired conical shape. Eventually the sheet reaches the cooper, who rolls it into cylindrical form, drives on the hoops, and makes a barrel of it.

The Chemung Geological Formation.—The conclusions of Prof. John J. Stephenson's review of the relations of the Chemung and Catskill formations on the eastern side of the Appalachian basin, as expressed in his address at the American Association, are that the series from the beginning of the Portage to the end of the Catskill forms but one period, the Chemung, which should be divided into three epochs—the Portage, the Chemung, and the Catskill; that the deposits of the Catskill epoch were not made in a closed sea or in fresh-water lakes; that the disappearance of animal life over so great a part of the area toward the close of the period was due to gradual extension of the conditions existing in southeastern New York as early, perhaps, as the Hamilton period; and that the Chemung period should be retained in the Devonian.

Scenery of the Mustagh Glaciers.—In his description, before the English Society of Arts, of the Pamirs and neighboring regions, Captain F. E. Younghusband gave a picturesque account of the scenery of the glacial regions of the Mustagh Mountains. The first object to attract attention in ascending the mountain streams is the appearance of what seem to be great heaps of gravel, with a stream issuing from their feet. Clambering up to the summit of one of these mounds, the traveler looks upward over a sea of needle-like pinnacles of ice, of every fantastic shape and variety of color, and among them sees long lines of rocky *débris*, the medial moraines of the glacier, "while on either hand mountains of stupendous height rise in stern and solemn glory." Among the pinnacles, or *serecs* of ice, "may be seen fairy-like caves and grottoes of pure ice, with icicles twenty or thirty feet in length hanging from the ceiling or formed in a delicate fringe across the entrance, and into the walls of these lovely caves one can look as into a sheet of glass." When the great snow-fields at the head of the glacier are reached, "all is white, pure, and unblemished; and the bold intruder is deeply and unforgetably impressed with the noble sublimity of the mountains towering round on every hand, and moved by his audacity in daring to intrude into regions ruled by Nature in such stern and silent grandeur. He feels, too, what tremendous forces are at work beneath the calm and placid surface; for, while at first sight all seems still and unchangeable, a glance around shows the glaciers rent into great chasms with perpendicular walls of ice, perhaps hundreds of feet deep, into which, if a stone is dropped, it bounds from side to side, and the echoes are heard coming up from the very heart of the glacier. And then a little observation shows that these vast seas of ice, motionless and immovable as they seem, are year by year forcing their way down the valleys, carrying on their icy bosoms the fragments and craigs of rock which have been broken off from the mountains by the nipping fingers of the frost. Great cliffs, too, are met with, worn away and ground by the glacier forced against them; and I have seen a whole cliff of limestone polished and smoothed by the glacier almost as well as small fragments of rock are by the hand of man."

Eastern and Western Weeds.—A comparative list has been published by Prof. Byron D. Halsted, made up from his own observations and those of his correspondents, of the weeds of New Jersey or the East, and Iowa or the central West. Of 297 weeds in Iowa, 210 are native and 87 are foreign; and they are further classified as 51 worst weeds, 94 bad weeds, and 152 indifferent weeds. In passing from the worst weeds through the middle class to the indifferent, the percentage of perennials rapidly increases. In New Jersey, 135 weeds are native and 130 are

foreign; and 55 are worst, 98 are bad, and 112 are indifferent. The weeds in Iowa not found in New Jersey are mostly of the indifferent class, native in large part of the prairie, and as a rule quickly disappear when the land is placed under cultivation. The New Jersey list can be made up from the one for Iowa by omitting 75 of the native prairie plants, mostly perennials, and adding 43, a large percentage of which are annuals. The only single weed of the first rank stricken from the Iowa list in adapting it for New Jersey is a species of pigweed, but even this has within a year been found in New Jersey. On the other hand, there are several first-class (worst) weeds that are added in the adaptation of the Western list to the East. Of such, for example, are a pepper-grass, the wild radish, two kinds of cocklebur, feverfew, wild onion, wild leek, nut-grass, Bermuda grass, and a kind of chess. The East is overrun with a larger number than the West of the most aggressive weeds—"weeds that assert their ability to resist the forces of the cultivator and plant their banners upon the tilled ground, likewise annual weeds that stock the soil with a multitude of seeds, ready to spring into life whenever an opportunity offers. Some species of weeds, such as a goose-foot, a pigweed, a thistle, plantain, shepherd's-purse, and purslane, are found everywhere from Maine to California; others are prominent on the Pacific coast and not elsewhere; and there are weeds peculiar to the Rocky Mountain region, and others to the prairie region. In the middle prairie States it is mostly the members of the sunflower family that prevail. In the central States the list is led by the Canada thistle, quack-grass, docks, daisy, chess, plantain, and purslane. If to this list we add wild carrot, onion, and parsnip, and the like old foreign enemies, we have the extensive catalogue of these plant pests that prey upon the lands of New England.

Hypnotism as a Remedy.—Accounts are given by Dr. George C. Kingsbury, in his Practice of Hypnotic Suggestion, of fifty cases of pain or disease which he has himself treated by hypnotism. In forty-five of these, complete cure followed, without any relapse so far as is known, and there was at least some slight or temporary relief in the five others. In one case the hypnotism was used as an anæsthetic in childbirth. The patient was hypnotized twelve times in preparation for her confinement, and once more when it began. She was brought to the convenient stage of hypnotic somnambulism in which she could understand and obey orders and nevertheless felt no pain. In the treatment of three patients of confirmed drunken habits some remarkable results in the way of sobriety, or even dislike for alcohol, were obtained, which had lasted up to the time of the publication of the book, nine months or more, and none of them was known to have relapsed. In many lesser ills, such as neuralgia, headache, toothache, etc., the relief of the pain was immediate and complete. The author has found no damage done by hypnotism in careful hands.

The Weather and Influenza.—A paper by Dr. Lang, of Munich, treats of the relations between influenza and changes of weather. Among atmospheric conditions favorable to the development of infectious maladies are light and rare precipitations, while the soil dries out and dust abounds, and next slight winds. Such conditions prevail in anti-cyclones. But not every barometric maximum that occurs can be accused of being a promoter of an epidemic. The germs of the disease must be present, then the anti-cyclone is a danger. Entirely local conditions can not be held to account for what passes in the atmosphere, nor for events that depend on its constitution, for the air is not, like us, fixed to the ground. It is continually suffering displacement, and brings us elements from all the places over which it has passed. We must look, therefore, to the place where the wind started—that is, to the center of the aërial circulation of the region in which we are. We know that the distribution of barometric pressure is a determining cause of the movements of the air, and it may be that the corpuscles scattered through the atmosphere have been brought from far-off regions, especially if the distribution of the pressure has continued the same during a considerable time. In the winter of 1889–'90 a barometric maximum was fixed for six weeks in the eastern part of Europe, with only unimportant modifications in its shape and extent. Now, since

the East included the starting-point of the epidemic of influenza that prevailed then, it is presumed that this atmospheric condition favored its extension toward the West. The views expressed by M. Masson, of Paris, before one of the medical societies of that city, substantially agree with these. The period of greatest mortality from grip in Paris, from November, 1889, to February 1, 1890, was marked by a constantly higher pressure than the average; the temperature did not fall below 5° C.; the hygrometric condition was high, and radiation fell off from the very beginning of the epidemic. In the principal capitals of Europe, according to M. Masson's investigations, the grip coincided in general with a humid, foggy condition of the atmosphere, and only moderate cold and an unusual height of barometer. It was so at Vienna, Berlin, and Brussels. But in Russia, where the grip is endemic, the mortality increased when the barometer fell and the thermometer rose, and the mean humidity was augmented. At St. Petersburg it disappeared when the pressure rose and the cold became more intense. For all other regions M. Lang's and M. Masson's rules were verified.

The Parapee Palm. — According to a note in Garden and Forest, the Parapee palm (*Guilielma speciosa*) is cultivated by the Indian aborigines of the Guianas for its fruit, which they use largely as food. They plant it about their settlements, and, where it is found apparently wild in the forests, examination will show that such situations were formerly occupied by the Indians. In some seasons the fruit is produced without seed, while in other seasons it contains seeds, the variation occurring in the fruit of the same trees from season to season. When boiled or roasted the fruit has something of the texture and taste of a dry, mealy potato. It is palatable and very nutritious. The fruits, which are individually about the size of a pigeon's egg, are borne in bunches of from forty to sixty together. There are two or three bearing seasons in a year.

Preservation of Minerals and Fossils. — Minerals and fossils are not exposed to the ravages of insects, like zoölogical collections; but many of them are liable to destruction by deliquescence and efflorescence. Deliquescence is the property possessed by some bodies of attracting moisture from the atmosphere and dissolving in it. There is no means of preventing these accidents, except inclosing the specimens in hermetically sealed envelopes. Efflorescence is a property possessed by other bodies of falling into powder. There are several ways of protecting specimens against it. Fossils converted into white pyrites, or the substance of which is impregnated with salts and not susceptible of being washed, should be fully dried and covered with a varnish that will not scale, and they can also be dipped in oil. Impressions in danger of being rubbed off can be consolidated by impregnating them with a thin solution of gum arabic, a little sugared to prevent its cracking. Mr. Chalande recommends for the preservation of rocks, fossils, bones, etc., liable to split or fall into efflorescence, placing them for from one to twenty-four hours, as the case may demand, in a bath, made by mixing equal parts of silicate of soda or potash and water, and drying after the bath. This gives the piece a considerable degree of hardness. For the preservation of pyritous fossils, M. André Fonville recommends preservation in paraffine; this, however, is only adapted to small specimens; and for fossils of considerable size, like ferns, sigillaria, etc., he advises the silicate-of-soda method. To consolidate fossil bones, M. Lambert recommends coating with boiling melted whalebone. The hot matter penetrates the pores and becomes very hard. If any of it remains on the outside of the specimen, it may be removed with blazing paper. Gelatine and strong glue, used by many persons, are good, but not so good as the whalebone application.

The "Silver Thaw." — The "silver thaw," as described by R. C. Mossman, of Ben Nevis Observatory, occurs during an inversion of ordinary temperature conditions, when the temperature is considerably lower at the surface than at higher altitudes, and the rain congeals as it falls. In the six years from 1885 to 1890, 198 cases of silver thaw were observed at Ben Nevis, with a mean duration of four hours and a half in each case. They nearly all occurred between November and March, during times of per-

fectly developed cyclones and anti-cyclones. Ninety per cent of the cases occurred when the thermometer was between 28° and 31·9°, so that the greater number of cases occurred just before a thaw. The most common type of cloud which preceded both cyclonic and anti-cyclonic cases of silver thaw was cirro-cumulus, frequently accompanied by cirrus and cirro-stratus; and the changes showed that the higher strata of the atmosphere came first under the influence of the moist current, which took from three to eight hours to descend to the height at which cumulo-stratus forms.

Our Destructive Locusts.—Eight kinds of destructive locusts are described in Prof. C. V. Riley's paper on that subject as infesting the United States or parts of its territory. The first is the Rocky Mountain locust (*Caloptenus spretus*), which has caused great destruction at times in its sudden, temporary appearances in the Western States and Territories. Its permanent breeding-ground, where it breeds every year and is always to be found in greater or less numbers, embraces the larger part of Montana, a narrow strip of western Dakota, all but the northwestern quarter of Wyoming, the central and northwestern parts of Colorado, small tracts in Utah, Oregon, and Idaho, and a large area in the British possessions north of Montana. The subpermanent region, where it is liable to breed for a few years and then disappear, lies immediately east of this; and the temporary region, where it appears for single seasons, includes large territories east and south of the subpermanent region. The lesser migratory locust (*Caloptenus atlantis*) breeds annually in abundance from middle Florida nearly to the Arctic Circle. It has been marked as injurious in New England in nineteen seasons since 1743. The non-migratory red-legged locust (*Caloptenus femur rubrum*) has a common range with the previous species, but is rarer in the eastern part of its range, while it becomes abundant in the Mississippi Valley. It causes only local damage, and few cases of destructive appearance have been recorded. In common with the differential and two-striped locusts, it often gives cause for alarm by devastating grass-lands or growing crops. The California devastating locust (*Caloptenus devastator*) is a Pacific species, of which fifteen local destructive visitations are recorded. The differential locust (*Caloptenus differentialis*) ranges through Illinois, Missouri, Nebraska, Kansas, and Iowa, and is found in Indiana, New Mexico, and California. Though not migratory, it is capable of making considerable flights, and is sometimes locally destructive. The two-striped locust (*Caloptenus bivittatus*) has an extensive range, covering most of the country. It is distinguished by its two lateral stripes reaching from the head to the extremities of the wing-covers. It often becomes locally abundant enough to do much damage to crops. The pellucid locust (*Camnula pellucida*) occurs in the far West and in Maine, Massachusetts, Vermont, and Connecticut. The Eastern and Western forms used to be considered two species, but the difference between them is not appreciable. The American Acridium (*Schistocerca americana*) is our largest locust, being more than two inches and a half long. It occurs throughout the Southern States, through Mexico into Central America, and as far north as Illinois and Indiana. It is sedentary within the bounds of the United States, and becomes only locally destructive. Farther south, it is said to possess the migratory habit.

Objects of Forest Management.—Forest management, says Prof. B. F. Fernow, in his excellent paper on What is Forestry? has two objects in view, of which the first is to produce and reproduce a certain useful material, and the second to sustain or possibly improve certain advantageous natural conditions. In the first case we treat the forest as a crop which we harvest from the soil, taking care to devote the land to repeated reproduction of crops. In the second case we add to the first conception of the forest as a crop another, namely, that of a cover to the soil, which, under certain conditions and in certain locations, bears a very important relation to other conditions of life. The favorable influence which the forest growth exerts in preventing the washing of the soil and in retarding the torrential flow of water, and also in checking the winds and thereby reducing rapid evaporation—further, in facilitating subterranean drainage and influencing climatic conditions, on account of which it is

desirable to preserve certain parts of the natural forest growth and extend it elsewhere—this favorable influence is due to the dense cover of foliage mainly, and to the mechanical obstruction which the trunks and litter of the forest floor offer. Any kind of tree growth would answer this purpose, and all the forest management necessary would be simply to abstain from interference and leave the ground to Nature's kindly action. This was about the idea of the first advocates of forest protection in this country. But would it be rational and would it be necessary to withdraw a large territory from human use in order to secure this beneficial influence? It would be, indeed, in many localities, if the advantage of keeping it under forest could not be secured simultaneously with the employment of the soil for useful production; but rational forest management secures the advantages both of favorable forest conditions and of the reproduction of useful material. Not only is the rational cutting of the forest not antagonistic to favorable forest conditions, but in skillful hands the latter can be improved by the judicious use of the axe. In fact, the demands of forest preservation on the mountains, and the methods of forest management for profit in such localities, are more or less harmonious; thus, the absolute clearing of the forest on steep hill-sides, which is apt to lead to desiccation and washing of the soil, is equally detrimental to a profitable forest management, necessitating, as it does, replanting under difficulties. Forest preservation, then, does not, as seems to be imagined by many, exclude proper forest utilization, but, on the contrary, these may well go hand in hand, preserving forest conditions while securing valuable material; the first requirement only modifies the manner in which the second is satisfied.

The Zebra's Stripes.—It has been shown by several authors that the stripes of the zebra are a means of protection to it in the forests, by producing light effects like those of the limbs of the bushes by which it is surrounded. One can readily see, says a correspondent of Nature, how the shadows of the branches in a tropical forest, falling upon the zebras, would so intermingle with the stripes of the animals as to add enormously to the difficulties of recognition by human eyes, and also by the eyes of their animal foes. This correspondent believes that the stripes have a still deeper meaning and value. At night, when the animal is lying down partly on its side and partly on its belly, and doubles up its legs, the horizontal stripes on them run in the same general direction with the vertical ones of the body and seem to be continuations of them; or, if it rests on its side and stretches out its limbs, the vertical, diagonal, and horizontal stripes would then be more horizontal than anything else, but pointing in different directions, and would so assimilate themselves with the crossed and varying directions of the shadows as to have the same practical effect in hiding the sleeping animal from its foes.

An Ancient Japanese Burial Custom.—Prof. Hitchcock, of the Smithsonian Institution, calling attention, in a paper on Ancient Tombs and Burial Mounds of Japan, to some small clay figures representing human beings, said it was an ancient custom in Japan to bury the retainers of a prince standing upright around his grave. The compassion of the Emperor Suisina (97–30 B. C.) was aroused by the sufferings of the persons who were thus treated when his younger brother died, and he desired to change the custom. When the empress died, the plan was proposed of substituting clay figures of men and horses for the living victims. From the publication of an edict in the year 646 forbidding the burial of living persons, and also the burial of gold, silver brocade, diaper, or any kind of variegated thing, it is inferred that the custom of living burial was kept up to some extent till the seventh century. Specimens of the figures, called *tsuchi ningio*, introduced to take the places of the living sacrifices, are now very rare, and this fact leads to the supposition that the figures were not buried, but were left exposed on the surface of the ground.

The Lung-fish.—The *Ceratodus* or lung-fish of Queensland, according to Prof. Spencer's account of it in the Australasian Association, lives only in the Burnett and Mary Rivers, in Queensland, and belongs to a small group which may be regarded as intermediate between the fishes and the amphibia.

The swimming bladder of ordinary fishes has been modified so that it serves as a lung. In Africa, *Protopterus*, a form closely allied to *Ceratodus*, makes for itself a cocoon of mud, in which, during the hot, dry season, it lives, and can breathe by means of its lung. The *Ceratodus* does not appear to do this, and probably never leaves the water. It comes continually to the surface, and passes out and takes in air, making a faint spouting noise. The author suggested that the lung was of the greatest service to the animal, not during the hot but during the wet season, when the rivers are flooded and the water is thick with sand. The *Ceratodus* appears to be herbivorous, and feeds largely on the seeds of gum trees which fall into the water.

Dealing with Contagions.—A report by Dr. A. Jacobi calls attention to some peculiar difficulties in dealing with the contagion of scarlet fever and diphtheria. No general hospital must admit patients suffering from either disease. Hotel-keepers are not willing to admit them; but if cases get lodgment within their houses, it is to their interest to conceal the fact. Their interest, however, does not go so far as to induce them to destroy or disinfect curtains and carpets, and purify the walls of rooms, and the contagion is perpetuated. Rooms and suites of rooms in large and expensive hotels are known in which cases of diphtheria have occurred for several years in succession, all provoked by the same germ, lodged in the same curtains and carpets. The same danger lurks in private houses, where the well members are imperiled by the presence of the sick one, and all the surroundings are liable to be infected; and in tenement-houses, where close contact of the well with the sick can hardly be avoided. Patients should be removed from homes and hotels and isolated; but this is impossible, for the want of provision for the proper care of such cases. The only institution for these diseases in New York is the Willard Parker Hospital, which is in a remote part of the city, and has beds for only seventy patients, while twenty-five hundred persons die annually of the infections. Plans for new hospitals are proposed by the Medical Society of the City of New York, and with them stations or refuges, where the children of families in which diphtheria or scarlet fever is prevailing can be housed until the patients at home have recovered or been removed, and their residences, bedding, and furniture have been thoroughly disinfected.

Treatment of Potato Disease.—The treatment of potato disease with sulphate of copper has been found efficacious at Nantes, France. A dressing of three pounds of sulphate of copper to twenty gallons of water, or of two pounds of sulphate of copper and four pounds of lime to twenty-five gallons of water, is used. The best results are obtained by using whole potatoes, sound, of medium size, selecting those which show the finest germs, and cutting very large ones in two. Before planting they are steeped for twenty-four hours in a bath composed of six pounds each of sulphate of ammonia and nitrate of potash and twenty-five gallons of water; then allowed to stand twenty-four hours to give the sprouts time to swell—whereby the growth is quickened and the return is increased. Disease in tubers is arrested by dipping them in a bath of water and as much lime as it will take, and drying them. The diseased part seems to solidify after this treatment, and does not spread, while the good part continues sound.

Propagation of Fine Flower Seeds.—From an address by Mr. George F. Daniels, quoted in Garden and Forest from the Journal of Horticulture, we learn that the increased demand for flowers in England and America has given a corresponding impetus to seed-growing abroad, where they have the advantage of cheap labor and a climate especially adapted to the work. The secret of successful cultivation in Germany lies in the bright, dry autumn, which enables seeds to stand longer and become more thoroughly ripened. The soil is also well adapted for the purpose. Stocks are one of the most expensive crops, in the item of labor, because the finer varieties have to be grown in pots, and they require attention in watering. China asters are grown by acres, one firm devoting more than a hundred acres to them. Petunias require much attention, as each bloom has to be fertilized by hand to insure the setting of the seed. The pollen from the double blooms is very difficult to obtain, the flowers being so dense that they have often

to be removed from the plant, then placed in wet sand and pulled open, so as to allow the sun and the air to ripen the pollen, which is carefully removed and placed on the finest single blooms. Calceolarias are shy seeders, and the most careful hybridization is necessary to insure a crop. Every bloom is examined, and the pollen is taken from the stamens and placed on the pistil. As the operation must be performed when the pollen is quite ripe, the flowers must be looked through nearly every day to catch each bloom as it comes to maturity. Seed is very difficult to obtain from carnations, and then only in small quantities. The commoner kinds of annuals are grown in masses. The plan of improving stocks of seed is as follows: As soon as the plants are fully in bloom they are carefully examined, and the best and truest in color or shape are marked by placing a stick next to them. When the seed is ripe they are carefully gathered by themselves, and kept for stock the following year. This is very necessary in case of some annuals, which show a great tendency to revert to the wild state; at the same time it improves the stocks from year to year.

Aluminum in Food-vessels.—Opinions still differ with regard to the value of aluminum for use in food-containing vessels. Messrs. Lübbert and Roscher asserted several months ago, in a paper on the subject, that aluminum was too readily acted upon by food-substances or other substances used in cooking, for its application in the construction of kitchen utensils to be safe. Prof. Lunge afterward instituted experiments on the subject, from which he concluded that coffee, tea, and beer had practically no action on aluminum, and the action of brandy was very slight; while that of acids and acid liquids (wine, sour milk, and fruit juices) was more pronounced, but still too slight to cause alarm. Taking the worst case, that of acetic acid, this author found a maximum attack of five milligrammes per one hundred square centimetres in six days; so that a given vessel, kept always full, would be reduced to half its original weight in fifty-five years. This, he holds, is too trifling an action to be considered. There is no danger of any injurious action upon the human body by aluminum compounds, which, moreover, are not poisonous as compounds of arsenic, mercury, lead, and copper are poisonous. Before they can act injuriously, a quantity will have to be ingested a hundred times larger than he found to be regularly entering the stomach in this way. Finally, he adds, aluminum may be employed without fear for canteens or any other vessels used to hold food, at least at ordinary temperatures. Against these conclusions is a report on the authority of the telegraph of a soldier near Nuremberg, Germany, who was taken sick after drinking cognac from his aluminum flask. On analysis of the brandy it was found to be muddy, and to contain roundish, black particles, which proved to be aluminum and iron. But in this case we had not simple corrosion of aluminum by brandy, but galvanic action of the liquor, aluminum, and iron, with resultant corrosion. Further investigation of the subject is needed.

Photography in Colors.—M. G. Lippaman announces that he has perfected a method of photographing in colors which he mentioned to the French Academy of Sciences fourteen months ago, and has exhibited very brilliant spectra which he obtained without the interposition of the colored screen. The author claims to have obtained the compound colors of natural objects as well as the natural colors of the spectrum. He exhibits a series of plates representing a window of four colors—yellow, green, blue, and red; a trophy of French and other flags; a plate of oranges with a red poppy on top; and a many-colored parrot. The window and the parrot are of dazzling brilliancy. They were photographed with the electric light in ten minutes. M. Lippaman admits that the plates require in practice too long an exposure, and that it will be necessary to make them more sensitive.

Influence of Natural Surroundings on Human Character.—Captain F. E. Younghusband makes a remark in one of his accounts of central Asiatic exploration, on the influence of the natural surroundings on the character of the people of a country. "It has been my fortune," he says, "to travel in very varied descriptions of country—in the dense, gloomy forests of Manchuria; over the bounding grassy steppes of Mongolia; across the desolate wastes of the Desert of Gobi;

and among the mountain valleys of the Himalayas and the Hindu Kush. Each different type of country produced its own peculiar impression upon me, and has enabled me to appreciate perhaps more keenly than I otherwise should have done its particular influence upon the inhabitants. The forest produces a feeling of indefinable repression; one seems so hedged in and hampered about, and longs to be free of the endless succession of trunks of trees, and to be able to see clear space in front. Far preferable, in my opinion, is the desolation of the desert, which, depressing as it may be, in some way produces also a feeling of freedom; and on the open steppes an irresistible desire to roam and wander seems to come over one, which I can well understand was the motive power which caused the Mongol hordes under Genghis Khan to overrun the rest of Asia, and part even of Europe. Again, with these Mongols of the desert and the steppes a stranger is always hospitably received, and there is little of that dread of people from the outside so frequently met with among barbarous nations. The Kirghiz of the open Pamirs, too, have some of these characteristics. But directly one enters the narrow, shut-in valleys, such as are found on the southern slopes of the Hindu Kush and the Himalayas, one finds the ideas of the people shut in too. They have a dread of strangers; they desire, above all things, to be left to themselves, and unless forced by over-population to do so, or led away by the ambitions of a chief, seldom leave the particular valley to which they belong."

Ratios of Illegitimacy.—A table of statistics of illegitimacy in Europe, published by Dr. Albert Leffingwell, shows the Irish to be the most virtuous of all the peoples, the ratio of illegitimate births among them being twenty-six in every thousand. The English rate is forty-eight, and the Scotch eighty-two per thousand. Thus we may roughly say that for every child born out of wedlock in Ireland two are born in England and three in Scotland. In Europe at large, Ireland is closely followed in its place of honor by Russia, with the low rate of twenty-eight per thousand, and by Holland with the rate of thirty-two per thousand. The Italian and French rates are respectively seventy-four and eighty-two per thousand, comparable with the rate in Scotland. Among the countries that show the highest proportions of illegitimacy are Sweden, Saxony, Bavaria, and Austria, in which the rates range from one hundred to one hundred and forty per thousand. Austria is at the opposite pole from Ireland, and takes the lowest place in morality among the European nations, with a rate of one hundred and forty-six per thousand. The inquiry into the causes of these varying rates of illegitimacy raises complicated and interesting problems. The causes generally supposed to be principal factors in the matter are poverty, ignorance, and the contamination of great cities. Examining the influence of these, Dr. Leffingwell finds it very slight. In Ireland, the lowest rates are in the poorest counties. Russia, with one of the lowest rates, is one of the poorest countries; and the author affirms that "there is nowhere such uniform relation between the indigence of a people and the prevalence of illegitimacy as to justify the hypothesis that this phase of moral delinquency in any district or country can be accurately described as caused by its poverty. As little can the influence of great cities account for the prevalence of illegitimacy. Education and creed appear to have little influence. We must seek the real factors in race and heredity, legislative restraints upon marriage, social usage, and other like circumstances."

Value of the Applications of Anthropology.—In a paper on Anthropology as a Science and as a Branch of University Education, Dr. D. G. Brinton thus estimates the value of the applications of this science: "In government and law, in education and religion, men have hitherto been dealt with according to traditional beliefs or *a priori* theories of what they may or ought to be. When we learn through scientific research what they really are, we shall then, and then only, have a solid foundation on which to build the social, ethical, and political structures of the future. It is the appreciation of this which has given the extraordinary impetus to the study of sociology—a branch of anthropology—within the last decade. Anthropology alone furnishes the key and clew to history. This also is meeting recognition. No longer are the best histories mainly chronicles of kings and wars, but records of the develop-

ment and the decline of peoples; and what constitutes 'a people,' and shapes its destiny, is the very business of ethnology to explain. So likewise in hygiene and medicine, in ethics and religion, in language and arts, in painting, architecture, sculpture, and music, the full import and often unconscious intention of human activity can only be understood, and directed in the most productive channels, by such a careful historical and physical analysis as anthropology aims to present."

Science Teaching in Preparatory Schools.—The report of the Committee of the American Society of Naturalists on Science Teaching in the Schools embraces the answers from the colleges and preparatory schools in the North Atlantic States between Maine and the District of Columbia, to a circular of questions respecting what they require of scientific instruction. Of sixty-nine colleges from which answers were received, only eighteen require science for admission to the course for the degree of Bachelor of Arts. Eleven other colleges require science for admission to the scientific course, while forty colleges offer no recognition of the place of science in the pre-collegiate course. Of twenty-one institutions catalogued as scientific schools, ten do and eleven do not require some science for admission. Of one hundred and forty-one preparatory schools, ninety-eight include science in the course preparatory for the classical course in colleges. These facts seem to indicate that the academies and high schools are in advance of the colleges in the recognition of the claims of science. The report, analyzing the courses of instruction of the schools, shows that the plea that time can not be found for scientific study in the four years of preparatory school instruction is not well founded. The greatest difficulty in securing the right kind of scientific instruction in the schools arises from the lack of properly trained teachers. This difficulty is vanishing, and the number of teachers is increasing who possess an acquaintance with science which, though limited in scope, is in considerable part sound in method. "Let it be clearly recognized that the teacher of science demanded even in the primary schools is not one who has committed to memory some verbal propositions about science, but one who has learned to observe and experiment, to compare and reason, and the conditions are already in existence which will not fail to supply that demand."

Miss North and her Animals.—Miss Marianne North, a British naturalist and traveler, whose death we noticed several months ago, exhibits in her recently published "Recollections" a happy appreciation of the individual eccentricities of animals. A favorite dog of her father's, which was implicitly trusted, when left one day in a room with a tempting pigeon pie, could not resist stealing a pigeon, but replaced the bird with the blackened sponge which Mr. North used to wipe his pens. Miss North made friends with the sacred baboons in the Indian temples, "who came and sat by her side to criticise her drawing, or who, after breaking out in the tricks of their unregenerated monkey nature, would suddenly fold their arms and relapse into pious imbecility, as if they had been disciples of Buddha, and were meditating on the Nirvana. She commemorates her first impressions of the Queensland kangaroos, when she saw fifty come hopping down hill in single file, ludicrously manœuvring as if moved by machinery, and using their big tails for balancing rods. Shortly afterward she saw a bear taking a siesta in the fork of a tree, who merely cocked his great ears and yawned when her attendants shied stones at him. He knew he was out of harm's way. He took his constitutional only at night, and was not going to alter his habits to please anybody. She tells a capital story of a cockatoo, brought up in a zoölogical garden, and taught to say: 'Walk in, ladies and gentlemen; don't all come at once—one at a time.' The bird escaped, and was found with a troop of wild cockatoos attacking it. It was lying on its back, fighting beak and claw, and screaming out: 'Come on, ladies and gentlemen, come on; not all at once, one at a time.' She heard of a South African baboon, who, having taken to brigandage, had assailed a musician returning from a dance, and captured his accordeon. Examining his prize, there was a dismal discord, followed by a hideous howl, and the robber vanished in a panic, leaving the booty behind. She encumbered herself with a family of opossum mice, and this cost her endless trouble and anxiety." But these mice proved extremely serviceable

in her journey across the North American continent, for they excited such intense interest with railway guards, hotel-keepers, etc., that they always insured their mistress civility or a cordial reception.

Wild Plants as Fungus-nurseries.—Prof. B. D. Halsted shows, in a paper on fungi common to wild and cultivated plants, that in many cases diseases are transmitted by spores from one genus or family as well as from one species to another. A bacterium that affects the tomato and potato causes a disastrous form of blight in melons, cucumbers, and squashes. The apple rust that yellows the foliage of the orchard in July is identical with the *gynosporangium* that produces the galls, swelling out to large size in rainy weather, on cedar trees, and the spores are transmitted in alternation from one tree to the other. It is thus shown by many examples that the evil influences of plant funguses may act at long range. The lesson may be learned from the experiments that "if so much of the smut, rust, mildew, mold, rot, and blight of our cultivated plants is propagated by the wild plants hard by, it may be wise for every crop-grower to pay attention to what is thriving outside of his garden wall."

Skill of Prehistoric Lapidaries.—The most superficial examination of any fairly large collection of stone implements, says Mr. Joseph D. McGuire, in a paper on the materials, apparatus, and processes of the aboriginal lapidary, is calculated to convince the observer that man in his lowest stage of development was well acquainted with the methods of fracture of various stones, and also that he was a most skillful workman. The articles found in burial-places, in caves, and shell-heaps, as well as surface finds, furnish conclusive evidence that man often carried material many hundreds of miles for the purpose of fashioning, at his leisure, objects of personal adornment or domestic utility as well as weapons. The evidence of progress in the manufacture of tools made by man is easy to find: "From the splinter of bone or piece of stone used in the hand to the diamond drill of to-day is an immense advance, but it can be traced, step by step, without a break. The author has himself experimented on the manufacture of stone implements, using tools similar to those of the North American Indians, and beginning with the raw material. The principal work done was the pecking of stone with the stone hammer, and the carving, polishing, rubbing, and boring of stone with the rudest appliances. The result of the experiments goes far to prove that the time required for the manufacture of stone implements by primitive man was very short." If the time occupied by the writer was short, it is fair to conclude that a skillful workman, using the materials which long experience had taught him were the best for his purpose, would accomplish the task in much shorter time. The author, in his paper, records his experiments in pecking nephrite, kersantite, catlinite, obsidian, and basalt, with different hammering material, in drilling and boring, and in hammering copper, the results of which all went to confirm the view he has expressed.

Extermination of Species.—Some of the more obvious causes of the extermination of animals now going on, says Mr. Frederic A. Lucas, in his paper on that subject in the United States National Museum, are to be found in the systematic killing of animals for their various products, the destruction caused by domesticated animals introduced into new countries, and the bringing of wild land under cultivation. These causes most directly affect the larger animals, while smaller creatures are influenced by slighter ones. The erection of telegraph wires has proved destructive to birds, while other birds meet their fate by dashing against the electric lights. The extinction of the rhytina and the great auk, the almost complete extirpation of the bison, and the reduced numbers of the walrus, are good examples of destruction wrought directly by the hand of man; and, besides, there are the still more numerous instances of the very perceptible decrease of animals once abundant. Species used for food, or otherwise of economic value, suffer most; fashion affects some, some are necessarily destroyed for the protection of man and his domesticated animals, and others are killed merely for sport. The passenger pigeons, formerly visiting us by millions, are now unknown in places where they once abounded. Halibut, lobsters, and oysters are getting scarce, and the Atlantic salmon

and shad are practically kept from extermination by the efforts of fish commissions. One reason for this growing depletion of animals is found in the fallacy that, because some animals exist in large numbers, the supply is unlimited and the species needs no protection, which is indulged in till the species is on the verge of extermination. Usually, too, those most directly interested in the preservation of game are the bitterest opponents of protective measures, especially if the change will produce even temporary inconvenience. Although regret at the impending or actual extermination of a species is often purely a matter of sentiment, there is no lack of instances where the strictest utilitarian is quite as much interested as the naturalist in preserving a species from destruction. The pity of it is that in so many cases a small amount of protection would not only preserve for the naturalist the animals he wishes to study, but furnish the practical man with an additional source of wealth.

Concerning Overwork.—In treating the question whether laborious occupations in themselves may lead to premature strain of the body or mind, and so to degeneration or disease, Dr. P. H. Pye-Smith thinks we "must distinguish." Aneurism, emphysema, and some forms of cardiac hypertrophy may be the result of overstrained and too violent and prolonged exertion, from mechanical stretching of the great arteries by movements of the arms, from high blood-pressure, excessive calls on the heart, and over-long suspension of respiration, as in muscular efforts with a closed glottis. "We see similar results in horses which are put to too hard work at too early an age, and there is no reason to doubt the operation of such causes of disease in man. But their operation is limited to the production of certain definite lesions, and there is no evidence that harm is done, disease brought on, or life shortened by what is commonly known as work, whether mental, physical, or a combination of the two. The vanity of human nature is tickled by ascribing its disorders to such respectable antecedents as industry, energy, and intellectual activity. We must all have felt this when the results of habitual idleness or gluttony are ascribed by a patient or his wife to an overtaxed brain or too strenuous devotion to business—especially in the public service. There is no fear of any one of us" (members of the Royal College of Physicians) "using our brains too much for our health, nor do I believe that mental labor or honest work of any kind interferes with health or shortens life a day. Even if it did, who would not rather be worn in use than rust in idleness? Who would not choose a short-spanned life, filled full of action and of thought, of sorrow and of joy, of effort and of endurance, of enjoyment of living one's self and helpful service to others, rather than to wear out a tedious existence of monotonous ease?"

Agriculture in Egypt.—The land of Egypt was irrigated in ancient times by turning the red water from the Nile at high flood into the basins into which the country was divided by the construction of earth-banks at convenient distances. The water was allowed to stand at a depth of three feet or more for forty or sixty days, till the earth had become saturated and the weeds had been killed, and the fertilizing layer of finely divided red mud had been deposited on the soil. The water being drawn off into the receding river, the seed was sown upon the soft mud. Sometimes the ground was left till it was dry enough to be plowed, and was then planted. In either case sufficient moisture for the supply of the crop was retained. This system of irrigation has been supplanted for the most part in Lower Egypt by the canal system introduced by Mehemet Ali, but is still in use in Upper Egypt. The difference in the power of the two systems to maintain the fertility of the soil may be estimated from the fact that a good crop of wheat grown under the basin system of Upper Egypt yields about twenty-seven bushels per acre; while, unless specially manured, the yield runs down under canal irrigation to about eighteen bushels and a half. In the latter instance, the greater number of crops taken, and the reduced amount of Nile mud deposited, make artificial manures necessary. A combination of the two systems gives the best results. A wonderful store of natural manure, called *sabakh* has for a number of years been drawn upon by cultivators in the shape of refuse earth from the mounds of ancient villages, and from the floors and

surroundings of the mud huts of the present generation. The water of the Nile holds in its volume an unusually large percentage of air; and it is probably due to this circumstance that it is so healthful and palatable even at its reddest. The crop seasons are divided into three different productive periods: the autumn, or *nili*—August till the end of November; the period of flood, in which maize, millet, sesame, and a few minor crops are grown; the summer, or *sefi*—April till July; the warm-weather period, in which tropical and semi-tropical crops—rice, sugar, and cotton—are produced; and the winter, or *shitawi*—December to March, or cold-weather period—when the European crops, grown in a temperate climate, come to maturity.

Spring Two Hundred Years ago and now.—Has change of climate within historical times, Dr. P. H. Pye-Smith asks, brought about change of diseases? "I think," he says, "we may assert that, with a few important exceptions, such as the draining which has led to the general disappearance of malaria, and the improved habitations of the poor, which have made plague unknown and typhus rare, no such changes have taken place; and in particular that there is no foundation for the opinion that in former time the English spring was milder than at present. 'The uncertain glory of an April day' was as uncertain at the close of the sixteenth as at the close of the nineteenth century. In the seventeenth century the great Earl of Verulam met his death from standing in the snow on Highgate Hill on Easter Monday, and Evelyn remarks, under date of March 27, 1681, 'An extraordinary sharp spring, not a leaf yet on the trees.' In the eighteenth century Horace Walpole writes that 'the spring has set in with its usual severity'; and the contrast between poetical description of the 'ethereal mildness of spring' and its actual inclemency has become a commonplace of satire."

Typhoid Fever and Sewage in Drinking-water.—Outbreaks of typhoid fever occurred in several of the half-dozen cities and towns situated near the junction of the Hudson and Mohawk Rivers during the winter of 1890–'91, and, while their cause can not be fixed with certainty, Prof. William P. Mason, of the Rensselaer Polytechnic Institute, holds that there is good reason to attribute them to a contaminated water-supply. In a paper read to the Franklin Institute he states that every one of these places drains into the Hudson River or its tributary, the Mohawk. There were epidemics of typhoid fever in Cohoes, West Troy, and Albany, which take their supplies of water from one or the other of these rivers; but in Waterford and Lansingburg, which take water from the Hudson above this group of towns; in Troy, which uses in part a similar supply and depends partly on the lakes back in the hills; also on Green Island, opposite Troy, which obtains sand-filtered river-water from wells, there was little or no fever besides imported cases. Ice-cutters at Van Wie's Point, four miles below Albany, who used the river-water for drinking, also had the fever break out among them. It is true that typhoid germs were not found in the water, but the facts above cited are certainly worthy of careful consideration.

Sulphuring Dried Fruit.—The dainty whiteness which commercial dried fruits have taken on within a few years is due to an unwholesome bleaching by means of the fumes of burning sulphur, which is practiced in the drying factories. Fruit-driers say that sulphuring makes the fruit dry quicker, keep better, and sell better. But these advantages do not benefit the consumer, who suffers the disadvantages, which are loss of flavor, impossibility of distinguishing unripe and poor fruit from good, and the presence of sulphide of zinc in fruit that is dried on trays having a zinc surface. This matter is thoroughly ventilated in the Transactions of the American Public Health Association by Dr. Joel W. Smith, who says further that the contamination with sulphide of zinc was the reason why American evaporated apples were excluded from Germany. He also quotes from a paper read by J. L. Mosher at a fruit-growers' convention in California the statement that "if fruit be picked before ripe, and over-sulphured to produce whiteness, it is devoid of its true rich taste and flavor, and *only requires polishing to make buttons.*"

Physiology of Over-exertion.—Pertinently to the death of a young Englishman,

twenty-two years old, from syncope brought about by cold and over-exertion attendant upon a bicycle-ride of forty miles, the Lancet remarks: "It appears that this young man was a practiced bicycle-rider, and to such forty miles could hardly be considered an excessive run in a day; but, besides distance, many things have also to be considered by the judicious rider—for instance, the nature of the roads, the weather, and perhaps, above all, the pace. We know that the new machines are capable of attaining a speed never thought of a few years ago. A high speed through such cold air as prevailed on Good Friday must often be very dangerous, as likely to cause pulmonary congestion, to overcome which the heart will work at a high degree of tension, and, like any other muscle, it is likely to become paralyzed from overwork; and herein lies the danger from swift and hard riding. It would be well if our young men would remember the advice that an eminent English physiologist gave to a young man some years ago, 'Observe your strength, and keep within it.'"

NOTES.

Between four and five acres have been assigned in the forthcoming World's Columbian Exhibition to the Educational Exhibit. This is a much larger space than ever was offered before to this interest at a World's Fair. In order that the most advantage may be derived from this large privilege, the Bureau of Education has published a circular of suggestions of details as to the arrangement of the exhibit, in order that it may be made as comprehensive as possible, and as accessible in all its parts. A statement concerning the National Catholic Educational Exhibit, which has been determined upon, is printed on the same sheet with the department's circular.

It appears, from M. W. Brennaud's studies of the Surya Siddhanta, a book which contains the astronomy of the Hindus, that they were acquainted with the precession of the equinoxes and its effects, and with the theory of lunar and planetary movements. They had determined with fair exactness the diameter of the earth and the distance of the moon; they could calculate the orbits of the planets by the aid of the moon's daily motion in its orbit; could calculate and predict eclipses of the moon and the sun; and had a respectable knowledge of most of the fundamental problems of astronomy.

Observations made by M. Obrecht, at the observatory in Santiago, Chili, since July, 1891, show that the ground in the northwest quarter rises daily between noon and nine o'clock in the evening, and then falls back gradually till seven o'clock in the morning. Furthermore, there is a continuous rising movement of the southeast quarter, and from September to November a continuous rising of the eastern quarter. The daily variations had been observed by M. Moesta at the time the observatory was built, and by Gillis.

A few months since the Kew authorities dispatched, per the steamship Atrato, a botanical commission to the West Indies with a number of Wardian cases containing vine cuttings and Gambier plants. Unfortunately, cold weather set in, and the efforts to convey these tender plants, which had so often ended in failure, threatened once more to result in disappointment. The difficulty was that if kept on deck they would be inevitably destroyed by the low temperature; while, if taken below, the absence of light, which is so necessary to the existence of the delicate Gambier plants, was almost certain to be equally fatal. Under these circumstances it occurred to Mr. Morris to avail himself of the electric light, of which there was an abundance on board the Atrato. The experiment proved in every way successful.

The extent of the influence a lake may exercise upon climate is illustrated by the statement of M. Forel that the quantity of heat accumulated in Lake Leman during the summer is equivalent to that which would be given out by the burning of fifty-one million tons of coal. A railroad train carrying this coal would be eighteen thousand kilometres long, or nearly the length of the earth's meridian from pole to pole.

A story is told of a brown retriever dog in London which was sent to carry a letter in its mouth to drop in the post-box at Piccadilly. It got to the box just as the postman, having emptied it, was starting away. The dog seeing him, ran after him, caught up with him, put the letter in his hand, and then went off with the satisfied air of a dog that had done its duty.

Of the "rare metals," didymium is quoted at $4,500 a pound; barium, at $3,700; beryllium or glucinum, at $3,375; yttrium, at $2,250; rhodium and niobium or columbium, at $2,000 each; vanadium, at $1,875; iridium, at $700; osmium, at $625; palladium, at $500; and platinum, at $350. The price of the last metal, however, fluctuates between those of silver and gold.

M. Berthelot has traced the derivation of the word bronze to the city of Brundusium, now Brindisi, where was the seat of

certain manufactures in which the alloy was employed. A Latin manuscript of the age of Charlemagne, found in the library of the chapter of the Canons of Luynes, gives a receipt for the "composition of Brindisi"—copper, two parts; lead, one part; tin, one part.

AMONG the interesting objects exhibited at a recent *soirée* of the Royal Society was a proof-sheet of the Archæological Survey of Egypt, by Mr. Percy E. Newberry, showing all the successive stages of a wrestling-match between a black and a white man, with more than a hundred different positions recorded. The white man seems in many of the pictures to be getting the worst of it.

A FOOLISH report that the Department of Agriculture contemplated introducing the mongoose to contend with the rodents of the Western plains, so troublesome to farmers—with the ultimate result, of course, of taking their place as a nuisance—has been denied by the department.

A NEW preparation of the potato has been introduced by M. Moulin, the inventor of the potato bread, and is intended chiefly for feeding to cattle. The cleaned potatoes are scraped or crushed; the pulp is pressed for the extraction of free water; is finely divided; and is dried with a moderate heat sufficient to give it a pleasant taste without converting the starch into dextrin. The product is called torrefied pulp. It may also be used for human food by making a *purée* of it, or by making bread of a mixture of it with flour or meal.

AT the last meeting of the American Philosophical Society in Philadelphia resolutions were adopted for the celebration in a worthy and becoming manner of the sesquicentennial anniversary of the society; and a committee of five members was appointed to make all necessary arrangements for the same. The society celebrated the centennial anniversary of its foundation in 1843, with a series of addresses, meetings, etc., continuing from the 25th to the 30th of May.

THE last giraffe in the London Zoölogical Gardens has recently died, and the institution is, for the first time since 1836, without a living specimen of this animal. It has had in all thirty specimens, of which seventeen were born on the place. The giraffe market is very poorly supplied, and there is but one specimen now for sale in Europe. The giraffe is practically extinct in South Africa, and can not be found within a thousand miles of Cape Town. There are still giraffes in East Africa, but there are no means of catching them.

THE aborigines of the Andaman Islands, a curious and even unique people, are said to be fast disappearing. All of them on two of the islands are dead, and only a few are left on a third. Only a small number of children are born, and they die in infancy.

THE Yahgan, one of the three tribes inhabiting Tierra del Fuego, according to Dr. Hyades, live chiefly on fish and mollusks. They also eat any kind of bird they can catch, and are fond of the flesh of the whale, the seal, and the otter. When pressed with hunger they will eat the fox, but never dogs or rats. Fishing is left to the women, while the men hunt. The people have splendid powers of digestion, and assimilate their food so rapidly that they sometimes become fat in the course of a single day. Their huts are made of branches or of the trunks of trees, the interstices being imperfectly filled up with moss or bark, with fragments of canoes, or with seal-skins. In the center is a fire, around which the inmates sleep at night, and at other times, when they have nothing else to do, sit talking and laughing. The Yahgan lose early the attributes of youth, but often retain their vigor to a great age. They are very courageous, and enjoy games that test their physical strength.

WITH the exception of certain Eskimo throw-sticks, Mr. Otis T. Mason remarks in Science that all the weapons of the Northwestern American Indians examined by him are ambidextrous; and he questions whether outside of the Eskimo area any American aborigines had apparatus that would not fit either hand.

AMONG the particular schemes connected with the celebration of the Columbian quadricentennial is that for a great food exhibition to be held in New York in October, 1892, under the auspices of the Food Manufacturers' Association. It will include displays of manufactured foods and of products direct from the dairy, orchard, and sea, and a special department of dairy products, with daily afternoon and evening concerts.

OBITUARY NOTES.

THE death is reported of August Wilhelm Hoffmann, the eminent German chemist, Professor in the University of Berlin, and author of many discoveries that have contributed to the advancement of the science. A sketch and portrait of him were published in The Popular Science Monthly for April, 1884.

HENRI DUVEYRIER, a famous explorer and formerly President of the French Geographical Society, died about the beginning of May. He was born in 1840, and began, when twenty years old, a series of journeys in Algeria which made him famous. They included a reconnaissance to El Golea, where no European had ever set foot; southern Constantine and the Tunisian Soudan; the country of the Tuaregs; and the Chots of southern Tunis.